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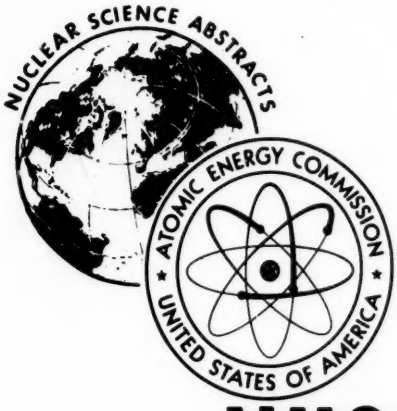

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NUCLEAR SCIENCE ABSTRACTS

Volume 20 Number 13

Abstracts 22530–24828

July 15, 1966

UNITED STATES ATOMIC ENERGY COMMISSION
Division of Technical Information

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NUCLEAR SCIENCE ABSTRACTS

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Volume 20, Number 13, July 15, 1966

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Division of Technical Information, Edward J. Brunenkant, Director.
Published by the USAEC Division of Technical Information Extension, Robert L. Shannon, Extension Manager.

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ACKNOWLEDGMENTS

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Volume 20, Number 13 July 15, 1966

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

Refer also to abstract 22853.

22530 (NIRS-4) ANNUAL REPORT, 1964. (National Inst. of Radiological Sciences, Chiba (Japan)). Dec. 1965. 103p. Dep. mn.

Separate abstracts were prepared for eight sections of this report. A list of publications during 1964 is included. (C.H.)

For abstracts of individual sections see: 22613–22616, 22800, 22872, 23374, and 23808.

22531 (TID-4204) RESEARCH AND DEVELOPMENT IN PROGRESS—BIOLOGY AND MEDICINE. Issue No. 4. (Division of Biology and Medicine (AEC), Washington, D. C.). Apr. 1966. 229p. Dep. mn. CFSTI $5.50 cy, $2.25 mn.

Indexes prepared by Division of Technical Information Extension, AEC.

Brief summaries are presented of research studies conducted in 1966 under contract with the Division of Biology and Medicine, United States Atomic Energy Commission. The objective of the biological, medical, and environmental research program is the development of scientific knowledge needed for full comprehension of possible consequences of the interactions of radiations with biological systems, with emphasis on overcoming the attendant hazards of nuclear energy and developing the useful potentialities of radiation in the life sciences. The studies include general radiation effects, toxicity of radioelements, radiation genetics, methods of combating the detrimental effects of radiation, molecular and cellular level studies, environmental radiation, radiological and health physics, instrumentation development, chemical toxicity, nuclear weapons effects, cancer research, food preservation, and selected beneficial applications of atomic energy in medical research and studies on animals and plants. Indexes are included for the principal investigator, contractor, and subject. (C.H.)

22532 ANALYSIS OF DISEASED AND NORMAL LUNG TISSUE FOR TRACE ANTIMONY CONTENT BY NEUTRON ACTIVATION ANALYSIS. Kennedy, John H. (Western Reserve Univ., Cleveland). Amer. J. Med. Sci., 251: 37-9 (Jan. 1966).

Neutron activation analysis was undertaken to seek a correlation between the presence of trace amounts of antimony in diseased lung tissue and pulmonary carcinogenesis in man. Involved and uninvolved lung tissue obtained from 24 patients was irradiated in a thermal neutron flux of 1.8×10^{12} n/cm^2 sec. with a comparator antimony standard. Results showed no indication that the concentration of antimony was increased in the involved and uninvolved lung in patients with lung cancer. In most patients with nonmalignant pulmonary disease, the range was the same. While the matter of industrial carcinogenesis and the possible relation of trace amounts of certain elements to lung cancer remains unsettled, there was no indication within the limits of this study that antimony is necessarily concentrated by lung cancer or related to pulmonary carcinogenesis. (TCO)

22533 USE OF URANYL FORMATE AS A NEGATIVE STAIN. Leberman, R. (Medical Research Council Lab. of Molecular Biology, Cambridge, Eng.). J. Mol. Biol., 13: 606(Sept. 1965).

In a search for heavy-metal compounds to enhance the detail visible in electron microscopy of viruses using the negative staining technique, the use of uranyl formate was investigated. In electron microscope studies on tobacco mosaic virus, detail visible on the particle images was improved with uranyl formate. Similar results were obtained for tobacco rattle virus. These results showed that uranyl ions can pack more densely into small crevices if counterions are small. Uranyl formate did not appear to offer any advantage over uranyl acetate in electron microscope studies of icosahedral viruses, where the structure may not be fine enough to be enhanced by a slightly denser stain. Nor did other denser metal salts tested appear to be better than the uranyl salts. Nevertheless, uranyl formate is a useful negative stain for studying fine structural detail of some macromolecules by electron microscopy. The salt used was prepared by dissolving uranium trioxide in fivefold excess of hot dilute formic acid. The solution was filtered and the filtrate evaporated by boiling until crystallization began. The crystals were collected by filtration, washed with cold ethanol, and dried. (BBB)

22534 EFFECT OF BONE MARROW TRANSPLANTATION ON THE SURVIVAL OF TUMOR-BEARING PATIENTS AND ANIMALS. Ishibashi, Yukio (Inst. for Infectious Diseases, Tokyo). Jap. J. Exp. Med., 35: 419-32(Oct. 1965).

Lower levels of antibody production to heterologous antigens were observed in tumor-bearing mice as compared with tumor-free controls. In cancer patients, however, no depression of humoral immune response was seen even in the terminal stages. On the other hand, delayed-type hypersensitivity, as determined by the tuberculin reaction and skin homograft reaction, was significantly weak in both cancer-bearing animals and patients. This lack of capacity to express the delayed-type reaction may be implicated in the development and progression of neoplasms. Markedly depressed homograft reaction in C3H/He mice with spontaneous mammary tumor was restored by multiple injections of bone marrow cells from normal mice of the same strain. Furthermore, isologous bone marrow transplantation was found to be effective in the prolongation of survival time of tumor-bearing animals. Immunity to homotransplants was not transmitted to normal subjects by serum, plasma, or even bone marrow from tumor-bearing animals immunized with the homografts. The transplanted bone marrow may break the tolerance of the host and induce antibody formation not only to homograft but to tumor antigens. (TCO)

22535 INTERNATIONAL SYMPOSIUM ON GENES AND CHROMOSOMES STRUCTURE AND FUNCTION, HELD AT BUENOS AIRES, ARGENTINA, NOVEMBER 30–DECEMBER

4, 1964. Valencia, Juan I.; Grell, Rhoda F. (eds.). Nat. Cancer Inst. Monogr., No. 18, 1-354(Dec. 1965). (CONF-734).

Nineteen papers discuss various aspects of the structure and function of genes, chromosome structure and replication, chromosome breakage and reunion, chromosome behavior, and chromosome metabolism. (C.H.)

Ecology

22536 (TID-22837) ECOLOGY OF ACANTHARIA IN RELATION TO Sr CIRCULATION IN THE SEA. Progress Report, July 30-December 1, 1965. Schreiber, Bruno (Parma Univ. (Italy). Istituto di Zoologia e Anatomia Comparata). Contract AT(30-1)-2607. 22p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Progress is reported on: ecology and systematics of Acantharia; measurements of radioactivity and presence of radionuclides in plankton and benthonic organisms; the radioactivity of coastal marine sediments; a micropaleontologic study of the systematics, the ecology of the Foraminifera in a core of the Adriatic Sea, and mineralogic and petrographic research by means of x ray diffractometry on the sediments of the Tyrrhenian Sea. (H.G.D.)

22537 (UCB-34P110-2) MONITORING OF SPECIES SPECIFIC RODENT ACTIVITY, WITH AN EVALUATION OF THE MODIFYING EFFECTS OF POPULATION DENSITY AND CLIMATIC AND BIOLOGICAL FACTORS. Final Report. Lidicker, William Z. Jr. (California Univ., Berkeley). Mar. 8, 1966. Contract AT(11-1)-34. 7p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Progress is reported in the measurement of population density and above-ground rodent activity at Rock Valley, near Mercury, Nevada. Weather and biological factors were correlated with activity. Data on the activity of Dipodomys merriami, obtained using radio transmitters attached to the animals and capacitance-proximity detectors, were compared with data obtained on D. merriami populations near Mohave, Calif. The avoidance of an ohmmeter attached to a ribbon line by kangaroo rats is reported. (C.H.)

22538 REMOVAL OF ^{239}Pu, ^{185}W AND ^{210}Pb FROM SOILS. Wilson, D. O.; Cline, J. F. (Battelle-Northwest, Richland, Wash.). Nature, 209: 941-2(Feb. 26, 1966).

The plant-soil interrelationship of ^{210}Pb, ^{185}W, and ^{239}Pu was investigated. The amounts of these radioisotopes removed from different soils by plants and the effectiveness of several extracting solutions in removing ^{239}Pu and ^{185}W from contaminated soils were determined. The uptake of the radioisotopes by barley was soil dependent. The activity in the extraction experiments for the various soils tested was 0.1 μC/g dry soil. Barley grown in the different soils accumulated only very small amounts of ^{210}Pb and less ^{239}Pu, but ^{185}W was accumulated in biologically significant amounts. The extracting solutions removed more ^{210}Pb and ^{239}Pu from the soil than did the barley. (M.C.G.)

22539 TRANSPORT OF GASES TO AND FROM GRASS AND GRASS-LIKE SURFACES. Chamberlain, A. C. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Roy. Soc. (London), Ser. A, 290: 236-65(Feb. 22, 1966).

A radioactive vapor of thorium-B (lead-212) was used to measure the vertical flux of a gas to grass and similar surfaces in a wind tunnel, as a function of the difference in vapor concentration between the air and the surface. Experiments were done over a range of values of the friction velocity and roughness length parameters. The results were analysed in terms of the reciprocal sublayer Stanton number B^{-1} of Owen and Thomson (1963), which is a measure of the degree to which Reynolds's analogy between transport of momentum and matter (or heat) breaks down at the surface. B^{-1} is equal to the difference between the dimensionless resistances of the boundary layer for momentum and for mass. (J.F.P.)

22540 GEOGRAPHIC DISTRIBUTION OF ^{90}Sr CONCENTRATION IN SHEEP BONES. Barreira, F. (Comissao de Estudos de Energia Nuclear (I.A.C.), Lisbon); Mendes, J. J. Amaral. Rev. Port. Quim. (Lisbon), 7: 145-53(1965). (In Portuguese).

The concentration of ^{90}Sr in sheep bones was evaluated. The animals were selected from different regions of the country and grouped in accordance with the administrative division. Differences were detected among the various regions. The results exhibited a correlation with the mean rainfall but the analysis also showed that this is not the sole factor to be considered in ^{90}Sr contamination. (auth)

22541 SORPTION OF CESIUM BY SOIL LAYER MINERALS. Titlyanova, A. A. (Ural Branch, USSR Academy of Sciences, Sverdlovsk). Soviet Soil Sci. (Engl. Transl.), No. 12, 1313-18(Dec. 1964).

The adsorption and desorption of ^{137}Cs was studied in various types of soils and pulverized minerals. Samples of each were shaken with ^{137}Cs solutions at concentrations of 10^{-9} to 10^{-2} eq/l and the radioactivity of the sediment was measured. Desorption of Cs was measured in water to which various cations were added. The specific adsorption of microquantities of cesium was found to occur in the mineral part of the soil. The percentage of cesium desorption from the humic acids was high and constant throughout the entire range of change in cesium concentration. The minerals biotite and phlogopite were characterized by a stable, low percentage of cesium desorption with all the cations tested in concentrations ranging from 4×10^{-11} to 4×10^{-8} eq Cs/g of mineral and by a sharp rise in the percentage of desorption in the region corresponding to increased concentrations of cesium. The desorption of cesium from muscovite by all three cations was effected much more easily. The desorption of cesium from vermiculite was very low in concentrations ranging from 4×10^{-11} to 4×10^{-7} eq/g of mineral. Desorption rose sharply with a Cs concentration of 10^{-7} to 10^{-5} eq/g of mineral. Desorption again decreased sharply with a cesium content of about 4×10^{-4} eq/g. The desorption curve for chlorite was linear over cesium concentrations ranging from 10^{-10} to 10^{-5} eq/g of mineral. Desorption rose sharply in concentrations close to saturation. Askanite and gumbrin adsorbed cesium more firmly than did bentonite. A feature of the desorption curves for most of the minerals investigated was the presence of a lower desorption plateau in cesium concentrations ranging from 10^{-11} to 10^{-8} or 10^{-7} eq/g of mineral. No clear-cut relation was noted between the amount of stably adsorbed cesium and the size of the surface of the mineral. It was concluded that the specific adsorption of microquantities of cesium is effected by secondary layer clay and primary micaceous minerals that are present in all soils. Therefore, the behavior of microquantities of cesium in each soil is determined by its mineralogic composition. (BBB)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstracts 22861, 23205, 23283, 23374, and 23380.

22542 (BNWL-SA-625) URINARY/FECAL EXCRETION RATIOS OF STRONTIUM AND CALCIUM IN THE RAT. Thompson, R. C.; Hackett, P. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1, 1966. Contract AT(45-1)-1830. 13p. (CONF-660513-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From International Symposium on Some Aspects of Strontium Metabolism, Annan, Scotland.

Following the intraperitoneal injection of ^{45}Ca and ^{85}Sr to mature rats on a high calcium diet, the ratio of urinary/fecal excretion of both radionuclides decreased with time post-injection. The decrease after 47 days was to $\frac{1}{2}$ of initial values in the case of ^{45}Ca, and to $\frac{1}{6}$ of initial values in the case of ^{85}Sr. This effect was shown to be due to an increase in excretory clearance via the intestine. (auth)

22543 (CEA-R-2897) ESSAIS RELATIFS AU DOSAGE DE ^{131}L'IODE DANS LE LAIT AU MOYEN D'ECHANGEUR D'ION ANIONIQUE. (Tests on the Measurement of ^{131}I in Milk Using Anionic Ion Exchangers). Jeanmaire, Lucien; Patti, Francois; Daburon, Marie-Louise; Gros, Roger; Bertrand, Suzanne (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan. 1966. 11p. Dep. mn.

Milk from a cow contaminated by a single ingestion of ^{131}I was passed over a Dowex 1 resin to fix the iodine it contained. The percentage amount fixed, originally around 100%, fell to 50% after 15 days. (auth)

22544 (CEA-R-2899) ETUDE DE LA REPARTITION DU BENZIMIDAZOLE ^{14}C CHEZ LA SOURIS APRES INJECTION INTRAPERITONEALE. (Study of the ^{14}C Benzimidazole Distribution in Mice after Intraperitonal Injection). Tyortyalian, Carlos (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Nov. 1965. 12p. Dep. mn.

In order to provide further information on the mechanism the distribution of benzimidazole in mice was studied using ^{14}C-labeled compound. Experiments showed that benzimidazole distribution is fast and homogeneous in all the tissues, but affinity appears at the level of stomach and gastric content. Elimination is made through the urinary system and is very fast. (auth)

22545 (CONF-640413, pp 128-31) BEISPIELE FUER DEN INTRAZELLULAEREN TRITIUM-STOFFWECHSEL. (Examples for the Intracellular Tritium Metabolism). Wenzel, M. (Freie Universitaet, Berlin (West Germany). Physiologisch Chemisches Institut).

After the addition of tritiated 2-lactic acid into cells of ascite tumors there is intercellular labeling of the DPNH by tritium. It was possible to obtain a complete balance of the incorporation of tritium in the different cellular components. Approximately 40% of the activity is present in water but some amino acids are labeled to a great extent. As a result the up-take of tritium into the proteins was relatively high, approximately 1%. The nucleic acids and the lipoids contain only 0.18 to 0.065% of the injected activity. (tr-auth)

22546 (CONF-640413, pp 132-6) MESURE DE LA CONTAMINATION DU CORPS HUMAIN. (Measurement of the Contamination of the Human Body). Verly, W. G. (Liege Univ. (Belgium). Laboratoire des Isotopes).

The impossibility of measuring the tritium contamination of the human body with external counters is pointed out. The use of urine analysis for the measurement of this contamination is discussed. The analysis of water in urine is quite adequate in the analysis of tritiated water or tritiated hydrogen oxidized into water. The measurement of the radioactivity of the dry residue is useful for substances that are not absorped or metabolized, and without vapor tension. The urinary excretion of tritium absorbed in organic form will occur principally in water. It is noteworthy that in the case of tritiated water contamination radioactivity from the anabolic assimilation of tritium is present in the dry residue. Analysis of other samples such as bone marrow, blood, or serum proteins is also considered. Use of results to calculate the body burden is discussed. The critical organ and the maximum permissible concentration levels for this type of contamination are defined. (tr-auth)

22547 (TID-21702) CERIUM, IRON, AND MANGANESE SORPTION BY SOIL COLLOIDS AND UPTAKE BY PLANTS. Kampbell, D. H.; Graham, E. R. (Missouri Agricultural Experiment Station, Columbia). [1963]. Contract AT(11-1)-1014. 19p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Calcium saturated clays (kaolinite, illite, Putnam, montmorillonite, and fibrous peat) were used to determine the influence of soil colloids on the uptake of ^{144}Ce, ^{59}Fe, and ^{54}Mn by corn plants. The plants were grown in an inert granular material (Perlite) above and below a layer of 5 grams colloid and 195 grams sand that contained the applied treatments and known amounts of the radioactive isotopes. Two weeks after emergence the plants were harvested, weighed, and assayed for radioactivity. The uptake of a trace amount of ^{144}Ce by the plants was greatly reduced by the presence of all colloids. Highest ^{144}Ce uptake as influenced by the colloidal systems occurred with kaolinite followed by illite, Putnam, montmorillonite, and peat in the order listed. Highest ^{59}Fe uptake occurred with the kaolinite system followed by Putnam with little difference in lower values from peat, montmorillonite, and illite. Highest ^{54}Mn uptake occurred with illite followed by kaolinite, Putnam, peat, and montmorillonite. An Mn-Fe interaction was apparent since a higher ^{54}Mn uptake decreased ^{59}Fe uptake with a sand medium. Nutrient solution phosphorus increased ^{144}Ce and ^{59}Fe uptake while ^{54}Mn uptake was not affected. Fifty ppM DTPA increased plant uptake of ^{144}Ce four-fold. A decrease of pH increased ^{144}Ce uptake. A plant species difference in ^{144}Ce uptake occurred with soybeans > peas > wheat > corn. (auth)

22548 (UCRL-16492) QUANTUM CONVERSION IN PHOTOSYNTHESIS: ELECTRON PARAMAGNETIC RESONANCE INVESTIGATIONS. Ruby, R. H. (Lawrence Radiation Lab., Univ. of California, Berkeley). Jan. 1966. Contract W-7405-eng-48. 60p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

A review is presented on the use of electron paramagnetic resonance (EPR) in understanding the energy conversion mechanism in photosynthesis. Experiments were also performed that reflect the belief that there exists a common physical-chemical description of all biological photosynthetic systems by the choice of a single system, a purple bacterium. Reference information on biological materials is presented with reference to variables affecting the EPR signal size in the following sequence: changes in chemical environment-mutants, poisons, removal of pigments, organic oxidants and reductants, and redox potential; temperature; light dependence of the EPR signal-intensity dependence, spectral response, transient response, and quantum yield. Information on signal parameters such as shape, g-value, and spin-lattice relaxation time is also presented. It was concluded that there has been little success towards identifying specifically the physical entity that produces the EPR signal. (83 references). (P.C.H.)

22549 SUBCELLULAR LOCALIZATION OF RADIOIODINE IN THE THYROID FOLLICLE OF THE RAT FOLLOWING THE ADMINISTRATION OF LOW AND HIGH DOSES OF ^{125}I. Nunez, Eladio A.; Money, William L.; Becker, David V. (Cornell Univ., New York). Acta Endocrinol., 51: 369-76(Mar. 1966).

As part of a study on the follicular localization of radioiodine in tumor and non-tumor bearing rats, high resolution radioautography was employed in rats that received low and high doses of radioiodide, ^{125}I. Subcellular localization of radioiodine was observed in the thyroid follicles of rats following the injection of 75 μC to 1000 μC of ^{125}I. Twenty-four hr after the injection of the smaller doses (75, 150, and 250 μC), the radioiodine was distributed evenly throughout the follicular lumen. Twenty-four hr after the injection of the large dose (1 mC) of radioiodide, there were two histological patterns of follicular radioiodine localization. In most follicles (about 85%) the radioiodine was distributed uniformly throughout the lumen. In the other follicles (15%), the activity was not uniformly distributed but was primarily localized along the cell-colloid border. At this interface, the radioactivity was entirely localized in the colloidal region. A possible explanation is that the follicles with an intracolloidal ring of radioiodine are more sensitive to the early effects of radiation and could be reflecting some cellular alteration. Furthermore, since relatively high doses of radioiodide inhibit thyroxine synthesis to a much greater extent than the iodination of tyrosine, it is speculated that the accumulation of radioactivity at the periphery of the lumen could represent that area of the follicle where iodination of tyrosine is occurring without subsequent coupling. (BBB)

22550 DISTRIBUTION OF ^{91}Y IN MICE STUDIED BY WHOLE-BODY AUTORADIOGRAPHY. Applegren, Lars-Erik; Nelson, Arne; Ullberg, Sven (Royal Veterinary

Coll., Stockholm). Acta Radiol. Therapy, Phys., Biol., 4: 41-8(Feb. 1966).

The distribution of ^{91}Y in mice was studied by means of whole-body autoradiography. Yttrium is predominantly taken up by the hard tissues with a localization similar to that of strontium. In addition, some soft tissues, such as renal cortex, ovaries, gastric mucosa and, in pregnant animals, the mammary glands and parts of the placenta, show a specific uptake. Of special interest is the strong concentration in the follicular walls of the ovaries with possible genetic consequences. The fetal uptake is relatively limited and concentrated to the fetal skeleton. (auth)

22551 ELECTROMECHANICAL COUPLING BY STRONTIUM. Hartmann, D.; Reiter, M. (Univ., Munich). Arch. Exp. Pathol. Pharmakol., 251: 151-2(1965). (In German).

The question of whether the role of Ca in the contraction of heart muscles can be taken over by Sr is considered. The effect of Sr^{2+} on the papillary muscle of guinea pigs was studied in Ca-free solutions incubated at 35°C with increasing concentrations of Sr^{2+}. Although the muscles in solutions free of Ca^{2+} and Sr^{2+} did not contract when stimulated, in the presence of Sr^{2+}, when stimulated at a frequency of 1/sec, they responded with contractions whose magnitude was proportional to the Sr^{2+} concentration. When Sr^{2+} alone was present, the isometric contraction curves were twice as long as when the same concentrations of Ca^{2+} were present. The transmembranal action potential was extended three fold with increasing Sr^{2+} concentrations. At concentrations above 4.8 mM of Sr^{2+} the action potentials decreased. The velocity of the development of tension was half as great with Sr^{2+} as with equimolar concentrations of Ca^{2+}. Since the lengthening of tension development with Sr^{2+} was ~ half the doubling of the rise time observed, then on the average the peak tension developed was as great as that developed with the same Ca^{2+} concentrations. The results suggested that the physiological coupling function of Ca^{2+} in the contraction of heart muscles could be taken over basically by Sr^{2+}. However, results of the stimulation and contraction process with Sr^{2+} made it possible to conclude that Sr^{2+} has less specificity, because the lengthened duration of the action potential suggests some effect on membrane permeability, the reduced speed of tension development suggests activation of the fibrillar adenosine triphosphatase, and lengthening of the mechanical use times suggests its intracellular inactivation. (BBB)

22552 MOSSBAUER SPECTROSCOPIC EVIDENCE FOR LOW-SPIN IRON IN DEHYDRATED METMYOGLOBIN. Caughey, Winslow S.; Fujimoto, Wilfred Y.; Bearden, Alan J.; Moss, Thomas H. (Johns Hopkins Univ., Baltimore. Univ. of California, San Diego, La Jolla). Biochemistry, 5: 1255-62(Apr. 1966).

Enriching myoglobin with ^{57}Fe permits high sensitivity Mössbauer spectroscopy of the protein. Protein enrichment has been accomplished by combining enriched protoheme (92.8% ^{57}Fe) with apomyoglobin. A prominent feature of the Mössbauer spectroscopy of the lyophilized Fe^{3+} protein is a line pair with quadrupole splitting of 2.04 ± 0.02 mm/sec, indicating that the iron is in the low-spin state ($S = \frac{1}{2}$). This result is in contrast to magnetic susceptibility measurements of the material in solution that indicate high-spin iron ($S = \frac{5}{2}$). Two possible mechanisms are suggested for stabilization of the low-spin state in the dehydrated protein. One previously proposed for anhydrous hemoglobins involves coordination of a second histidine(E7) to the iron; the other involves a subtle change in bonding at the iron site due to removal of water bound at the surface of the protein. The temperature-dependent line broadening of the Mössbauer spectrum, observed over a range from 4.6 to 298°K, arises from magnetic interaction between the iron electrons and the nucleus, coupled with the temperature dependence of the electron spin-lattice relaxation time. (auth)

22553 GROWTH OF LEMNA IN H_2O-D_2O MIXTURES: ENHANCEMENT OF KINETIN. Cope, Benjamin T.; Bose, Shakuntala; Crespi, Henry L.; Katz, Joseph J. (Argonne National Lab., Ill.). Botan. Gaz., 126: 214-21(Sept. 1965).

Three species of duckweed (Lemna perpusilla, L. gibba, L. minor) containing a very high proportion of fixed deuterium were grown successfully. Experiments were performed on the effects of both protio- and deuterio-glucose and of kinetin on the growth and morphology of the Lemna species in general, and of L. perpusilla in particular, in various concentrations of D_2O. Autotrophic growth in 50% D_2O was slow and produced small, fragile plants. Growth in this media showed a noticeable lag phase, often extending up to 4 days, and this resulted in synchronous division and growth. No autotrophic growth occurred in 60% D_2O. The addition of protio-glucose to the H_2O nutrient medium led to healthy plants. There was no lag phase, and a high exponential growth rate was obtained. Growth in 50% D_2O nutrient solution with added protio-glucose was also vastly improved over autotrophic growth, and it became possible to culture the plants in the region of 60% D_2O. Fixed deuterium content of plants grown with protio-glucose in 50% D_2O was 34 to 38%. In an attempt to raise this level, deuterio-glucose was substituted for protio-glucose. The fixed deuterium content was thereby raised to 48 to 58%, and a maximum of 59.4% was reached at a higher D_2O level. This rise in fixed deuterium had no harmful effects. The internal and external appearance of the fronds remained essentially similar to that of 50% D_2O-protio-glucose cultures except for a striking increase in root length. No growth occurred at 65% D_2O. In an attempt to counteract the deleterious effect of high D_2O levels, the medium was further supplemented with various additives. Most substances had no beneficial effect on the growth. Other additives exerted an adverse effect. Only kinetin proved beneficial in that it tended to normalize growth in 50% and 60% D_2O, but it only changed slightly the upper limit of D_2O in which growth would take place. With kinetin, Lemna grew at 63% D_2O, but if the D_2O level was raised to 65%, there was a complete cessation of growth, and the plants quickly died. It is speculated that D_2O has two principal effects: metabolic, which can be overcome by kinetin, and structural, for example, conformation of proteins, which is more sensitive to the D content of the water than to the nonexchangeable D in the protein. This would explain the sharp difference in growth at 63% as compared to 65% D_2O in the medium. (BBB)

22554 RADIOIODINE ^{131}I UPTAKE OF THE THYROID GLAND IN ATHEROSCLEROSIS. Ondrejicka, M.; Janotka, M.; Pechan, J. (Univ. of Komenskeho, Bratislava). Bratisl. Lek. Listy, 45: 474-85(Apr. 30, 1965). (In Czech).

The effect of atherosclerosis of ^{131}I incorporation by the thyroid gland was evaluated by comparative radioiodine uptake tests in 87 normal subjects and 60 patients with proven atherosclerosis. The effect of age on ^{131}I thyroid uptake was also investigated in both groups. A decrease in the ability of the thyroid to accumulate ^{131}I with advancing age was demonstrated in both groups but the trend was most pronounced in the atherosclerotic group. In the atherosclerosis group, thyroid function was normal in 77% and 57.5% of the 41-60 and 61-80 yr classes, respectively, with 23 and 42.5% of the subjects judged to be hypothyroid in these two groups. It is suggested that reduced thyroid functions may be of pathogenetic significance in atherosclerotic subjects. (BBB)

22555 SOME ASPECTS OF THE ACTION OF SOME PHARMACOLOGICAL SUBSTANCES IN URANIUM INJURY. Ivanitskii, A. M. Farmakol. Toksikol., 25: 631-4(Sept.-Oct. 1962). (In Russian).

Experiments were conducted on 250 female rats weighing 160 to 200 g to determine the effects of certain pharmacological substances in uranium injury. Doses of 200 mg/kg of uranium nitrate (40% of a lethal dose) were given by mouth to 120 of the rats, while 130 rats served as control. The development of uranium renal injury in the rats was characterized by the appearance of albumin, sugar (to 1%), and acetone in the urine, the greatest changes being observed 4 to 6 days after uranium ingestion. At this time the rats were injected intravenously with the following drugs: caffeine, Hexenal, strychnine, atropine, serine, ephedrine, Novocaine, cocaine, tetraethylammonium, cordiamin, papaverine, and Mercusal. The

changes of reactivity to these pharmacological substances as a result of uranium poisoning were examined. Change in response was not uniform for all of the substances tested. Enhanced reactivity of the poisoned rats to atropine and decreased reactivity to strychnine and Novocaine were noted, while the other pharmacological substances showed little change in their action. A convulsive action of caffeine, strychnine, and cordiamin was observed in some of the U-poisoned rats. The changes in drug reactivity are discussed. (BBB)

22556 RADIOIODINE IN MILK OF COWS UNDER VARIOUS FEEDING AND MANAGEMENT SYSTEMS. Fries, G. F. (Dept. of Agriculture, Beltsville, Md.); Burmann, F. J.; Cole, C. L.; Sims, J. A.; Stoddard, G. E. J. Dairy Sci., 49: 24-7(Jan. 1966).

Studies were carried out at Minnesota, Iowa, and Utah Agriculture Experiment Stations during August, September, and October 1962, to compare the effect of several feeding and management systems on iodine-131 concentrations in milk. Information was also obtained on the rate of change of milk iodine-131 concentrations following an abrupt change in diet and the rate of transfer of iodine-131 from feed to milk under field conditions. Milk from cows on pasture contained iodine-131 concentrations as high as 710 pC/l, whereas 60 pC/l was the highest concentration reached by any of the cows on stored feed. The rate of decrease in radioiodine concentration of milk when the animals were removed from pasture to stored feed could be resolved into a two-component system with half-lives of ~18 hr and five days. The degree to which cows were sheltered did not have a detectable effect on the concentration of iodine-131 in milk. These results indicate that freshly exposed feed is the only important source of iodine-131 contamination at the levels encountered in this study and would be the major source at higher levels of exposure. (BBB)

22557 LABELING, CONTROL, AND METABOLISM OF O-IODOBENZOIC ACID-^{131}I. Eysselt, M. (Medical Faculty Univ., Brno). Nucl.-Med., 5: 180-7(1966). (In German).

A method of preparing ^{131}I-labeled o-iodobenzoic acid and of determining its degree of purity is described. The metabolism of this substance in experimental rats and rabbits after parenteral and oral application was studied. Three radioactive substances were found in the urine of these animals: o-iodobenzoic acid, o-iodohippuric acid, and o-iodobenzoylglucuronic acid. Their proportions vary according to the kind of experimental animals and to the mode of application. The fate and metabolism of this substance was also studied in man after oral application. In this experiment, only o-iodobenzoylglucuronic acid was found in the urine. (auth)

22558 FATE OF INTRAVENOUSLY INJECTED RADIOGOLD ADSORBED ONTO CARBON PARTICLES AND ITS POSSIBLE APPLICATIONS. Razzak, Muhammad Abdel; Naguib, Mahmoud; Mustafa, Abdel Galil (Cairo Univ.). Nucl.-Med., 5: 197-205(1966).

The fate of intravenously injected ^{198}Au adsorbed onto carbon particles was studied in dogs after intravenous injection. The disappearance of radiogold on carbon particles from the circulation was so rapid that no significant amount of radioactivity could be detected in blood samples 5 minutes from the injection of this radioactive material into the femoral vein of anesthetised dogs. Furthermore, examination of the specimens obtained from the various internal organs proved that there was no measurable radioactivity in the heart, kidneys, and pancreas. Radioactive particles collected in the lungs amounted to 1 to 4% of the injected dose, and a small amount was deposited in the liver and spleen. The net radioactivity per gram of tissue from the liver and spleen was at most 2% of that found in a gram from the lungs. The level of radioactivity per gram of lung tissue was more in the basal regions than in the apices in 8 from the 13 animals examined. (C.H.)

22559 BEHAVIOR OF ^{222}Rn IN PISUM SATIVUM L. Kirchmann, R.; Berino, G. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Phyton, 22: 137-9(1965). (In French).

Pisum sativum was fed a normal series of nutrients to which 10 μC ^{226}Ra and an undetermined amount of its decay products had been added. After a week the plant was returned to a normal nutritive solution for 3 weeks. It was then sacrificed and various organs sealed in spectrometric measuring tubes. The ^{222}Rn produced by ^{226}Ra decomposition in the plant diffused through various cells and tissues, behaving as an inert gas. The probability of reaching the external surface and escaping into the atmosphere was very large, since the mean distance traveled by a Rn atom in its lifetime in water is about 3.1 cm, hence, the interruption of the decay scheme. (BBB)

22560 A STUDY OF WATER IN BIOLOGICAL SYSTEMS BY ^{17}O MAGNETIC RESONANCE SPECTROSCOPY. I. PRELIMINARY STUDIES AND XENON HYDRATES. Glasel, Jay A. (Columbia Univ., New York). Proc. Nat. Acad. Sci. U.S., 55: 479-85(Mar. 1966).

Preliminary results are presented from the investigation of the structure of water using a method which is particularly suited to the study of water in biological systems. The method utilizes wide-line nuclear magnetic resonance spectroscopy of water enriched with the stable isotope ^{17}O (spin = $^5/_2$, quadrupole moment, $Q = -0.0265$ barns[5a-c]). In addition to water alone, the structure of liquid water containing dissolved xenon is discussed. The method is applicable for use in studies of the anesthetic properties of xenon, and the general problem of anesthesia. (C.H.)

22561 ENHANCEMENT OF ^{137}Cs EXCRETION BY RATS MAINTAINED CHRONICALLY ON FERRIC FERROCYANIDE. Richmond, C. R.; Bunde, D. E. (Los Alamos Scientific Lab., N. Mex.). Proc. Soc. Exp. Biol. Med., 121: 664-70(Mar. 1966). (LA-DC-7500).

The effects of Prussian Blue (PB) on ^{137}Cs contamination in rats were studied in animals given PB via drinking water for 60 days at three different concentrations (0.025, 0.25, and 2.5 g/l). Continuous ingestion of ferric ferrocyanide (PB) at concentrations of 0.25 and 2.5 g/l in drinking water caused a significant reduction over a 60-day period in the whole-body retention of a single intravenous administration of ^{137}Cs. No effect was noted at a concentration of 0.025 gPB/l. The mode of action of PB appeared to be a binding of Cs atoms in the gut lumen and hence prevention of reabsorption, redeposition, and subsequent secretion via gut or kidney. Interruption of the enteral cycle resulted in accelerated radiocesium excretion, in addition to a smaller total number of Cs atoms in the major retention component. The urinary-to-fecal excretion ratio was reduced by a factor of about 20. (H.G.D.)

22562 THE ^{226}Ra, ^{210}Po, AND ^{228}Th IN BOVINE BONE AND TEETH. Lucas, Henry F. Jr.; Di Ferrante, Elvira R. (Argonne National Lab., Ill. EURATOM Biology Service, Brussels). Radiat. Res., 27: 718-26(Apr. 1966).

Mean concentrations of 0.55 pC of ^{226}Ra, 0.26 pC of ^{228}Th, and 0.74 pC of ^{210}Pb, per gram of ash, were found in bovine mandibles and teeth of twenty-five animals. Although the absolute values varied by factors of 8 to 40, the average concentrations of ^{210}Pb and ^{226}Ra in teeth ash were, respectively, 0.99 ± 0.30 and 1.03 ± 0.20 times the concentration in the bone ash. A detailed study of the ^{226}Ra concentration in each of the teeth available show that dietary ^{226}Ra intake may vary by a factor of 5 throughout life. Despite these variations in diet and growth rate, teeth appear to provide a good index of the whole-body content. The ratio of ^{228}Th to ^{226}Ra in the bone was 0.45, which is nearly the same as the ratio of 0.3 to 0.5 found for man. Average and highest dose rates in bone from all three nuclides were 0.13 and 0.40 rad/year, respectively, or fifteen to fifty times those found in man. (auth)

22563 UPTAKE OF RADIOACTIVE IODINE (^{131}I) IN NORMAL AND ALTERED THYROID GLAND FUNCTION. Kapitola, J.; Bleha, O.; Schuellerova, M. (Kralovy Univ., Prague). Sb. Lek., 67: 308-12(1965). (In Czech).

The results obtained from 295 tests of thyroid uptake of

^{131}I showed that the mean values for 81 patients without functional impairment of the thyroid were 23.6% after 4 hr and 39.9% after 24 hr. With increasing age the mean uptake values gradually declined. On the average the uptake values were higher in males than in females. In patients with altered thyroid function the ^{131}I uptake overlapped the normal range of values. In the hyperthyroid patients the mean value of uptake after 4 hr was 37.2%, and after 24 hr it was 56.6%. In thyrotoxic patients the 4 hr average value was 68.9%, and the 24 hr average value was 80.2%. In hypothyroid patients the 4-hr average value was 12.3%, and the 24-hr average value was 11.1%. In persons with clinically normal thyroid function with goiter the values may be increased. The authors stress the need for evaluation of the ^{131}I uptake in connection with the general clinical pattern. (BBB)

22564 THE DETERMINATION OF ISOTOPE EFFECTS BY GAMMA-RAY SPECTROSCOPY AND OTHER METHODS FOR STUDYING ACTIVE TRANSPORT PHENOMENA THROUGH BIOLOGICAL MEMBRANES. Wagener, K.; Landmann, M. (Harn-Meitner Inst. for Nuclear Research, Berlin). pp 71-7 of STI-PUB-106.

An analysis of biological transport processes shows that the separation of ions due to isotope effects may lead to useful information about the mechanism of transport. The applicability of such subtle indicators already present in the system is difficult in some cases, because certain constituents have only one stable isotope, and isotope effects can only be observed by adding artificial isotopes. The elements to be considered are Na, I, F, and perhaps some others, which are thought to be very important as biological trace elements (e.g., Co, Mn). The uncertainty of the determination of such isotope effects should be less than 0.5% because theoretically the finer details of the transport mechanism are only perceptible by recognizing deviations of isotopic abundance of the order of parts per thousand. The nuclides can only be determined by means of radiometric methods because of their very small quantity. However, it is more difficult to maintain the desired degree of precision by these methods than by means of mass spectrometry. In studies on the active transport of Na and K through the membrane of erythrocytes, three methods of radiometric analysis of isotopic abundance were investigated, namely: (1) Determination of the isotopic abundance of $^{22}Na/^{24}Na$ by comparison of the gamma lines 0.51 Mev (^{22}Na) and 1.37 Mev (^{24}Na) with a multichannel analyzer; (2) Determination of the isotopic abundance of $^{24}Na/^{23}Na$ by determination of the activity (^{24}Na) together with flame spectrometric determination of the total Na content of the sample; (3) Determination of the isotopic abundance of $^{39}K/^{41}K$: the ^{41}K content was determined by measuring the ^{42}K activity following neutron activation, and the total K content of the sample was measured by chemical or electrochemical methods. The results of these experimental methods are compared and discussed. (auth)

22565 NEUTRON ACTIVATION IN THE STUDY OF BONE SALTS. Haumont, S. (Universite Lovanium, Leopoldville, Congo); Roels, J. pp 295-300 of STI-PUB-106. (In French).

Sections of human bone were exposed to a thermal neutron flux. Gamma-ray spectrography showed that, 3 hr after activation, the main radiation came from the ^{24}Na. Autoradiography of the section at the same time shows the distribution of the sodium in the section. Fifteen days after activation, the gamma-radiation has disappeared. The beta-radiation then detected is due to the ^{32}P. The distribution of this ^{32}P can be found by further autoradiography. The distribution of the sodium and phosphorus in the same section can therefore be studied by carrying out autoradiography at two different times, i.e., at 3 hr and at 15 days after activation. This distribution can be compared with the calcium distribution obtained by microradiography. (auth)

22566 PHARMACOLOGY AND TOXICOLOGY OF DYSPROSIUM, HOLMIUM, AND ERBIUM CHLORIDES. Haley, Thomas J.; Koste, L.; Komesu, N.; Efros, M.; Upham, H. C. (Univ. of California, Los Angeles). Toxicol. Appl. Pharmacol., 8: 37-43(Jan. 1966). (UCLA-12-540).

A pharmacologic and toxicologic investigation in mice, guinea pigs, rabbits, and cats of dysprosium, holmium, and erbium chlorides showed that they have the same delayed acute toxicity and symptoms as the other members of the rare earth group. No changes in growth or hematologic values or evidence of histopathologic damage were observed after feeding the chemicals at three dose levels for 12 weeks. On all systems studied, the three compounds exhibited a depressant effect and produced death by respiratory paralysis coupled with cardiovascular collapse. All three compounds produced a dose-dependent decrease in the tonus and contractility of the isolated rabbit ileum. A nonspecific antispasmodic effect against both acetylcholine and nicotine was also observed, and the antispasmodic ED_{50}'s of the elements were ~ equal. A similar depressant action was also observed on the Trendelenburg guinea pig enteric ganglia preparation. Although it seems that dysprosium, holmium, and erbium have ganglionic blocking properties, such does not appear to be the case, because these chemicals did not affect the cat superior cervical ganglion preparation. Ocular application resulted in a transient conjunctivitis and ulceration. There were no effects on unabraded skin, but abraded skin showed extensive scar formation with epilation. The three chemicals produced nodules with foreign body giant cells and crystal formation when administered intradermally. Local irritation seems to present the greatest problem in regard to handling these materials, but proper industrial hygiene practices would prevent local damage. (BBB)

22567 ON LIVER PATHOLOGY AND CHEMISTRY AFTER ADMINISTRATION OF ^{239}Pu. Yolkina, N. I.; Tokarskaya, Z. B. (Inst. of Biophysics, Moscow). Vopr. Med. Khim., 9: 154-60(Mar.-Apr. 1963). (In Russian).

Experiments on ^{239}Pu poisoning were conducted in 46 rabbits and 28 adult mongrel dogs. Urea synthesis of the liver and formation of serum proteins were studied in the rabbits, and urea synthesis in the liver in 21 dogs. In the remaining seven dogs serum protein fractions and activities of serum glutamic-pyruvic transaminase (GPT), glutamic-oxaloacetic transaminase (GOT), and alkaline phosphatase were studied. Cirrhosis of the liver was seen in 75.5% of the rabbits that died after 180 days after Pu administration, but no distinct morphologic changes were noted in the liver of dogs during the first 180 days, and cirrhosis was seen >420 days after the introduction of Pu in the liver of only one dog. Total plasma protein content decreased gradually mainly on account of the decrease in albumin, was found in both rabbits and dogs. In blood plasma of the dogs a gradual increase of transaminase activity appeared; but the increase in GPT activity was more pronounced than that of GOT. A decrease of urea synthesis in the dogs was present during the development of pronounced cirrhosis of the liver. Serum alkaline phosphatase activity was increased only in the presence of distinct liver cirrhosis and jaundice. The decrease in plasma albumins and increase of transaminase activity preceded morphologic alterations in liver. In the course of 6 to 8 months all the animals died. (TCO)

22568 STUDIES ON THE TRANSPORT OF H_2O AND D_2O THROUGH THE ILEUM OF NARCOTIZED RATS UNDER THE INFLUENCE OF OXYTOCIN. Hemmerling, J.; Sterba, G. (Karl-Marx-Univ., Leipzig). Zool. Jahrb. Abt. Allg. Zool. Physiol. Tiere, 71: 451-74(1964). (In German).

Absorption of H_2O and D_2O from the ileum was studied in situ in Wistar rats narcotized with urethan. The absorption of 0.9% saline from ileum rose progressively in succeeding hours (up to 12 hr). Intravenous injection of saline led to a slight decrease in absorption rate. After intravenous injection of oxytocin in saline (0.003 to 0.040 IU/100 g body weight) continuous absorption was not affected. Low doses of synthetic vasopressin (0.002 to 0.030 IU/100 g) injected intravenously caused an initial increase in absorption rate, followed by a decrease, resulting in an overall rate not different from that in controls. With higher doses of vasopressin (0.030 to 0.070 IU/100 g) absorption is impaired because of increased peristaltic activity. After intensified peristalsis continued for several hours, ab-

sorption ceases. Experiments with D_2O showed that efflux of D_2O from ileum into body fluid is of an exponential nature and is merely a diffusion process. Absorption of D_2O was not affected by injection of vasopressin. The net flow of D_2O (and H_2O) from the intestine is interpreted in terms of an insorption and exsorption component. (BBB)

22569 CELL POPULATION KINETICS OF THE GINGIVAL EPITHELIUM. Skougaard, Mogens. Copenhagen, Rhodos International Science Publishers, 1965. 136p. (BNL–9226).

Thymidine, labeled with ^{14}C or ^{3}H, was used as a tracer for autoradiographic studies of cell population kinetics of the gingival epithelium of marmosets, Oedipomidas oedipus. Data on the tissue distribution of labeled thymidine are included. (113 references.) (C.H.)

Radiation Effects on Biochemicals

See also CHEMISTRY — Radiation Chemistry

22570 (AD–631144) RADIATION-INDUCED FREE POLYDEOXYRIBONUCLEOTIDES IN LYMPHOID TISSUES: A PRODUCT OF THE ACTION OF DEOXYRIBONUCLEASE I. Swingle, K. F.; Cole, L. J. (Naval Radiological Defense Lab., San Francisco, Calif.). Mar. 1, 1966. 28p. (USNRDL-TR–983).

Physico-chemical studies were made on the saline-extractable polydeoxyribonucleotides (PDN) occurring in lymphoid tissues of rats 4 hours after whole-body exposure to 600 rads x-irradiation. Viscosity, precipitability by acids and alcohols, and behavior on gel-filtration columns suggest a molecular weight less than that of undegraded DNA but probably greater than 10^5. Thermal transition curves indicate extensive complementary double stranding with slight fraying of the ends of the strands. In 0.2 M NaCl, PDN has a lower affinity for histone than does DNA. Susceptibility of PDN to the action of venom phosphodiesterase (EC 3.1.4.1) and resistance to spleen phosphodiesterase (EC 3.1.4.1) demonstrate the presence of 3′-hydroxyl terminals and the absence of 5′-hydroxyl terminals. Results suggest that PDN was formed from DNA by the action of a deoxyribonuclease I-like (EC 3.1.4.5) endonuclease rather than a deoxyribonuclease II-like (EC 3.1.5.6) endonuclease in the irradiated tissue. (auth)

22571 (BNL–9067) THE INFLUENCE OF TEMPERATURE ON DNA, RNA, AND PROTEIN SYNTHESIS IN PISUM ROOT MERISTEM CELLS MITOTICALLY INHIBITED BY CONTINUOUS GAMMA RADIATION. Van't Hof, Jack (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT(30-2)-Gen-16. 24p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Tritiated precursors of DNA, RNA, and protein were used to measure synthesis at 10 and 20°C in mitotically arrested meristem cells of Pisum roots that were continuously irradiated with gamma rays for 3 days to determine: if the arrested cells accumulated in a certain part of interphase; the degree of effect on DNA, RNA, and protein synthesis; if the effects were temperature dependent; and possible relationships between growth inhibition and altered synthesis. The results showed that the incorporation of DNA and RNA precursors was impaired by irradiation, and that decreased temperature further increased radiation impairment of DNA synthesis. Protein synthesis, on the other hand, was not impaired by irradiation at either temperatures. The number of DNA synthesizing cells was reduced to near zero by the combination of irradiation and decreased temperature. Cells synthesizing RNA showed a reduction in grain counts due to irradiation and lower temperature but still retained the ability to synthesize RNA. It was hypothesized that the combination of reduced DNA and RNA synthesis and unaffected protein synthesis resulted in precocious maturation of the arrested meristem cells. Growth that occurred in the absence of cell division was attributed to meristematic cells which precociously matured and cells which were in the region of elongation. (auth)

22572 (ORNL-P–1113) PHOTOPRODUCTS IN IRRADIATED BACTERIAL SPORES: NO THYMINE DIMERS. Donnellan, J. E. Jr.; Setlow, R. B. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 9p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

B. megeterium spores labeled with tritiated thymidine were irradiated with monochromatic ultraviolet light and the spore DNA analyzed for thymine containing photoproducts. No thymine dimers were observed, but large amounts of new thymine photoproducts were found. The unknown photoproduct was produced in vitro by irradiation of DNA dried in the presence of various salts. (auth)

22573 (ORNL-P–1316) ANTIBODY FORMATION IN ALLOGENIC RADIATION CHIMERAS: IMPAIRED CONVERSION TO 7S SYNTHESIS. Gengozian, Nazareth; Rabette, Barbara (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.); Congdon, Charles C. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 11p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Mice were given 950 R x rays and injected with syngeneic or allogeneic bone marrow. Six to eight months later they were given multiple injections of Salmonella typhoid antigen and the formation of 19S and 7S antibodies determined. The allogeneic radiation chimeras, although responding with almost normal levels of antibody after the booster injections, showed a relative defect in their ability to synthesize 7S antibody. The data suggest an abnormal immune mechanism in the presence of the immunologic tolerance existing between the host and the foreign hematopoietic graft. (auth)

22574 (ORNL-P–1331) EFFECTS OF UV-IRRADIATION ON MACROMOLECULAR SYNTHESIS IN ESCHERICHIA COLI. Swenson, P. A.; Setlow, R. B. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 42p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Several sensitive and resistant strains of E. coli B were examined for some of the factors that influence the inhibition of DNA synthesis by uv irradiation and some factors related to the repair of uv lesions. The quantitative analysis of the inhibition of DNA synthesis is described in terms of a model in which a pyrimidine dimer acts as a complete block to DNA synthesis. Effects of uv irradiation on RNA and protein synthesis in radiation resistant and sensitive strains are shown. (auth)

22575 (PRNC–80) EFFECT OF WHOLE-BODY GAMMA IRRADIATION ON SYNTHESIS AND EXCRETION OF GLUCURONIDES IN RATS. Chiriboga, Jorge (Puerto Rico Nuclear Center, Rio Piedras. UT–AEC Agricultural Research Lab., Oak Ridge, Tenn.). Dec. 1965. Contract AT(40-1)-1833. 55p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

Urinary excretion of glucuronides and free glucuronic acids in rats was found to be increased during the first 24 hr after irradiation with 1000 R when the rats were starved for 3 days before irradiation. Duodenal tissue from whole-body irradiated rats, tested in vitro, had a reduced ability to conjugate anthranilic acid, going down to 30% of the control level 48 hr after irradiation. At 192 hr after irradiation the conjugation again reached the normal level. Glucose added to the medium had no effect on control tissue but increased the conjugation of irradiated tissue. DPN increased the conjugation of tissue from normal animals but had no effect on tissue from irradiated animals. Uridine diphosphate glucose (UDPG) and UDPGA had no effect on normal or irradiated tissue. In live animals given naphthalene intragastrically or anthranilic acid subcutaneously at different intervals after irradiation with 1000 R, excretion of total glucuronic acid (free plus conjugated) was the same as in the controls. Levels of beta-glucuronidase excreted in urine by starved and irradiated rats were found to increase between 48 and 72 hr after irradiation. Urinary excretion of beta-glucuronidase inhibitor in irradiated rats was found to be the same as in the controls. A machine is described for automatic step-gradient elution in column chromatography of soluble uridine nucleotides. Preliminary

results are reported on the determination of their specific activity by using ^{32}P in rat tissues. (auth)

22576 (TID-21907) A STUDY OF DNA LABELED CELLS AT DIFFERENT TIMES AFTER RADIATION. PART I. Looney, W. B. (Virginia Univ., Charlottesville. Radiobiology and Biophysics Lab.).]1965]. Contract AT(40-1)-2889. 12p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Serial removal of the four liver lobes in rats that remain after partial hepatectomy, permitted study of the effects of radiation on somatic cells as a function of time following radiation. The most significant finding of the study is a decreasing percent of labeled cells with increasing doses of radiation. Almost all of the depression of DNA synthesis was found in liver specimens taken one hour after radiation. This is understandable since the labeled thymidine is only available for this period of time. There was a parallel depression of the rate of DNA synthesis and the percent of the cells synthesizing DNA. The percent of labeled cells was reduced from 26 percent in the controls to 4.7 percent in the radiated animals. The most plausible explanation for the increasing reduction of the percent labeled cells with increasing doses of radiation is the reduction of the cells actively synthesizing DNA. (auth)

22577 (TID-21908) THE DEPRESSION OF DNA SYNTHESIS, AND THE PERCENT OF CELLS SYNTHESIZING DNA IN RADIOSENSITIVE INTESTINAL CELLS AND RADIORESISTANT LIVER CELLS FOLLOWING RADIATION. PART II. Looney, W. B. (Virginia Univ., Charlottesville. Radiobiology and Biophysics Lab.). [1965]. Contract AT(40-1)-2889. 12p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A close parallel relationship between the depression of the rate of DNA synthesis and the depression of percent labeled cells synthesizing DNA with increasing amounts of radiation, given at a constant dose rate of 300 R/min is shown. The curves for the depression of both the rate of DNA synthesis and percent labeled cells can be resolved into two components when plotted semilogarithmically. The calculated ^{37}D dose of 570 rads and 32,000 rads was greater than the ^{37}D dose of ≅100 rads for most mammalian cell lines. The inability of the cells to synthesize DNA was, therefore, taken as presumptive evidence of cell lethality. The characteristics of the curves for rates of depression of DNA synthesis in the radioresistant liver cells of rats and the radiosensitive intestinal cells are similar. The magnitude of the rate of depression is greater in most instances in the cells of the intestines as compared to the cells of the liver. This difference may be the result of differences in the kinetics of labeled thymidine incorporation into DNA in the two organs; however, these differences may be related to yet unrecognized changes in the two organs. Further studies may, therefore, lead to better understanding of differences in radiosensitivity in mammalian cells. If the assumption is made that cell lethality is related to radiation-induced genetic changes at the molecular and morphological levels, then a number of studies in both lower and higher organisms would support the concept that cell death could be mediated through the genetic material. (auth)

22578 (TID-21914) THE EFFECTS OF DOSE RATE AND TIME OF IRRADIATION ON DNA SYNTHESIS. Chang, L. O.; Williams, S. S.; Looney, W. B. (Virginia Univ., Charlottesville. Radiobiology and Biophysics Lab.). [1965]. Contract AT(40-1)-2889). 7p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The radiosensitivity of DNA synthesis was studied in the cell cycle of regenerating rat liver. In vivo studies on DNA synthesis in x-irradiated 21-hr regenerating liver showed that: with a given total dose, the slower the dose rate of irradiation administered locally to the liver, the greater is the depression in DNA synthesis, in terms of DNA specific activity; a small dose of radiation (94R) produces a significant depression in DNA synthesis; and duration of irradiation is the key factor in producing this change, while the effect of dose is secondary. Therefore, it is concluded that the process of DNA synthesis is not radioresistant when low dose rates are employed. (H.G.D.)

22579 EFFECTS OF SELECTIVE IRRADIATION AT A CELLULAR PORTION WITH AN ULTRAVIOLET-MICROBEAM ON DNA, RNA OR PROTEIN SYNTHESIS OF NUCLEOLAR, NUCLEAR AND CYTOPLASMIC AREAS OF HeLa CELLS IN CULTURE. **Takeda, Susumu (Mie Prefectural Univ., Japan). Acta Haematol. Jap., 28: 285-7 (June 1965). (In Japanese).**

A selective portion of HeLa cells cultivated on a quartz coverslip by a hole-slide culture method was irradiated with a heterochromatic ultraviolet-microbeam (about 2μ in diameter) mainly for 25 seconds. The morphological effects were observed by phase-contrast cinemicrography and the biochemical effects on the DNA, RNA, or protein synthesis were examined by autoradiography in an observation period of about 24 hours, labelling with ^{3}H-thymidine, ^{3}H-uridine, or ^{3}H-lysine at various intervals after the irradiation respectively. The effects of the nucleolar irradiation on the nucleolar and nuclear RNA synthesis were estimated with percent-control-activities measured from grains over each cellular area. They were rapidly repaired from 10 to 20% and from 35 to 70% within a period of 3–4 hours, and showed further recovery to levels of 50 and 90% 24 hours after the irradiation. The irradiation dose of 25 seconds was effective for the enucleolation. The nuclear irradiation inhibited the nucleolar and nuclear RNA synthesis of the same cells at rates similar to the nucleolar irradiation, but their recoveries were completed within a period of several hours. It is suggested that the nuclear membrane has a barrier function. The protein synthesis was very resistant to ultraviolet irradiation at all cellular portions; even at the irradiated nucleolus the control-activity showed only a slight decrease. The effects of the irradiation on the DNA synthesis were examined. The nucleolar and nuclear irradiation resulted in a progressive inhibition irreversibly at least in a period of 8 hours after the irradiation. The cytoplasmic irradiation did not show a significant inhibition on the DNA synthesis. The effects of the nucleolar irradiation on cell division were examined on cine-films recorded for 24 hours after the irradiation at various periods of the mitotic cycle, using a system of the daughter cells. Results suggest that the nucleolar function concerning cell division has a critical point at the early G_2 period. The cine-micrographic observations indicated that 24 hours after the irradiation the irradiated nucleolus showed no or slight increase in its size and often a compensatory hypertrophy appeared in one or a few nonirradiated micronucleoli. In the autoradiographic experiment, results corresponding to these morphological findings were obtained. It may be said that HeLa cells have some nucleolar reservoirs. (auth)

22580 PHOSPHORUS METABOLISM IN ISOLATED NUCLEI. **Nakao, Makoto (Tokyo Medical and Dental Univ.). Acta Haematol. Jap., 28: 288-90 (June 1965). (In Japanese).**

Metabolism in nuclei is briefly reviewed. Phosphorus metabolism in isolated nuclei from rat bone marrow was examined. After exposure to 50 to 900 R of x radiation in vitro, the suspension of nuclei was incubated at 0° or 37°C with and without various substrates. The difference in hydrolyzable phosphate and ATP between the irradiated suspension and a control was quite small in contrast to Creasy and Stocken, but distinctly detectable. The differences were quite similar in various conditions. A tentative conclusion is that the primary effect might be nonspecific change of physical properties of DNA protein. (auth)

22581 CHROMOSOME ABERRATIONS IN HUMAN LEUKOCYTES IRRADIATED IN VIVO AND IN VITRO. **Ishihara, Takaaki; Kumatori, Toshiyuki (National Inst. of Radiological Sciences, Chiba, Japan). Acta Haematol. Jap., 28: 291-307 (June 1965). (In Japanese).**

Chromosome analysis was carried out on cultured leukocytes of people who received radiation under various conditions: people who had injections of Thorotrast about 25 years ago, patients with hyperthyroidism treated with radioiodine, fishermen exposed to fallout at Bikini 10 years ago, survivors from the atomic bomb, persons dealing with radiation in their occupation, and engineers of a radiation machinery factory who were accidentally exposed to about 50 R of radiation. An experimental in vitro irradiation, at dosages of 50, 100, 200, and 350 R, was performed on blood from a healthy male, and a chromosome analysis was carried out on the cultured leukocytes. The leukocyte cultures were prepared according to the method of Moorhead et al. with a slight modification. In every case, the frequency of chromosome aberrations was much higher than in normal persons. Chromosome type abnormalities such as dicentrics, rings, and other exchanged chromosomes not present in normal persons were frequently observed in the majority of the cases. The frequency of acentric fragments was very high in the cases of Thorotrast injection, ^{131}I treatment, and occupational and accidental exposures. The frequency of aneuploid cells was also generally higher in radiation-exposed persons than in normal persons. (auth)

22582 EFFECTS OF RADIATION ON THE CHROMOSOMES OF THE BONE MARROW CELLS. Ozono, Noboru (Hiroshima Univ.). Acta Haematol. Jap., 28: 308-18(June 1965). (In Japanese).

Chromosome studies were undertaken on the bone marrow cells of atomic bomb survivors in Hiroshima and of irradiated rats. No chromosome abnormalities in number or structure were found in 1968 bone marrow cells obtained from 39 individuals examined from 1962 to 1964 (16–19 years after exposure to the atomic bomb). Observations were made on the chromosomes of the bone marrow cells of rats at various intervals from three hours to ten months following 200 rads of x rays, ^{60}Co γ rays, and 14.1-Mev fast neutrons. There were a number of chromosome abnormalities, a majority of which were chromatid aberrations, within three hours after irradiation. As time elapsed the aberration rate fell rapidly, and stable chromosomal abnormalities such as pericentric inversions, chromosome deletions, and translocations were observed. Although frequencies of aberrant chromosomes were very low, they persisted ten months after irradiation. Morphological studies of the irradiated bone marrow indicated that most of the cells with chromosomal abnormalities observed shortly after irradiation originated from erythroblasts. Giant cells and multilobulated cells found 12–24 hours following irradiation were chiefly granulocytic. It seems likely that the formation of these nuclear abnormalities is brought about by mitotic inhibition and continuing DNA synthesis. These results were confirmed by autoradiographic analysis on the irradiated bone marrow. Types and frequencies of chromosome abnormalities induced by administration of Busulfan were similar to those induced by irradiation except for delayed appearance of abnormalities. It may be concluded that the effects of irradiation on the bone marrow cells depend on the cell-cycle phase at the time of irradiation. Chromosome abnormalities occur when the cells are irradiated between late DNA synthesis and prophase, and nuclear deformities occur when irradiated between pre-DNA synthesis and early DNA synthesis. (auth)

22583 KINETICS OF IRON AND COPPER LEVELS IN SERUM UNDER DIFFERENT DOSES OF WHOLE-BODY IRRADIATION IN RATS. Schmitt, W.; Braun, H.; Coenen, J. (Univ., Wuerzburg, Ger.). Arzneim.-Forsch., 19: 320-5(June 10, 1965). (In German).

Albino rats in groups were given whole-body radiation doses of 20, 50, 100, 200, or 600 R for studies of the blood serum iron, the blood serum copper level, and the latent and total capacity of binding iron. The determination of these metals was made 9, 72, and 144 hours following radiation. The serum copper level showed a biphasic course. The serum iron level increased initially with doses of 50 and 600 R but then decreased continually, as was also the case with those animals who received radiation doses of 20, 100, and 200 R. The latent capacities to bind iron were different: lethal doses caused a decrease and sublethal doses a moderate increase. The total capacity to bind iron shows approximately the same situation in the various groups as the latent capacity to bind iron. (auth)

22584 RED CELL MEMBRANE ATPase: RADIATION INACTIVATION ESTIMATES OF "SIZE". Kepner, Gordon R.; Macey, Robert I. (Univ. of California, Berkeley). Biochem. Biophys. Res. Commun., 23: 202-7(Apr. 19, 1966).

Fragmented ghost membranes prepared from human erythrocytes and freeze-dried were irradiated with 7.5 Mev electrons at a dose rate of 10^5 R/min. The radioinduced inactivation of the Na, K, ouabain sensitive ATPase suggest an inactivation volume of about 1.5×10^{-18} cm^3 with an equivalent molecular weight of about 1×10^6 for both the ouabain sensitive and ouabain insensitive ATPase systems. (C.H.)

22585 PREFERENTIAL INACTIVATION OF THE ALLOSTERIC FUNCTION OF ASPARTATE TRANSCARBAMYLASE BY X RAYS. Kleppe, Kjell; Sanner, Tore; Pihl, Alexander (Norsk Hydro's Inst. for Cancer Research, Oslo). Biochim. Biophys. Acta, 118: 210-11(1966).

The allosteric property of aspartate transcarbamylase from Escherichia coli was found to be more sensitive to x radiation than is the catalytic function of the enzyme. (C.H.)

22586 EFFECT OF LETHAL DOSES OF X IRRADIATION OF THE ENZYMATIC ACTIVITY OF MITOCHONDRIAL CYTOCHROME. Scaife, J. F. (Dept. of National Defence, Ottawa). Can. J. Biochem., 44: 433-48(Apr. 1966) 1966). (DCBRL-478).

The coupling of the tetrazolium salts triphenyltetrazolium chloride and nitroblue tetrazolium to the electron transport chain in mitochondria of thymus, spleen, liver, kidney, and Ehrlich ascites carcinoma cells was studied with several substrates. In experiments on succinate–triphenyltetrazolium chloride reductase activity it was possible to demonstrate a radiation lesion in the electron transport chain of mitochondria from thymus and spleen, but not in those from other tissues. This lesion is evident 4 hours after 25 rad of whole-body x irradiation, or earlier with higher doses. It is not prevented by the prior administration of aminoethylisothiouronium bormide, serotonin, vitamin K_1, or vitamin E, but is reduced by anoxic conditions. Lower levels of cytochrome c are found in irradiated mitochondria isolated from thymus, and the radiation lesion is believed to be produced by loosening the binding of cytochrome c to the mitochondrial after x irradiation. Decreased levels of ATP occur in thymus, spleen, and ascites cells following irradiation. (auth)

22587 EFFECT OF γ RADIATION ON THE ATP-ASE ACTIVITY OF ACTOMYOSIN. Coelho, Rose; Ehrlich, Elisabeth (CEA, Gif-sur-Yvette, France). Compt. Rend., Ser. D, 262: 1138-40(Mar. 7, 1966). (In French).

Radiation effects on the activity of ATP-ase of actomyosin at 1.5×10^5 rad was studied as a function of enzyme concentration. For a concentration below 0.750 mg/ml, this irradiation dose caused an inhibitory effect that was more marked as concentration decreased. However for concentrations above 0.750 mg/ml, an activation reaching a maximum of 75% with respect to the enzymatic activity of the sample actomyosin was observed for a concentration of 2 mg/ml. The activation decreased for higher concentration of irradiated solutions. (tr-auth)

22588 THE INFLUENCE OF X-RAYS ON THE ACTIVITY OF AMINOACYL-cRNA SYNTHETASES (pH 5 ENZYMES) OF AZOTOBACTER. Miroshnichenko, G. P.; Zaitseva, G. N.; Brinbaum, D.; Belozerskii, A. N. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 164: 1421-4 (Oct. 21, 1965). (In Russian).

In view of the lack of information concerning the activity of the aminoacyl-cRNA synthetase type ferments (I), acting during the first stages of biosynthesis of albumins, the effect of x radiation on such systems was investigated. Live

cells from the early, logarithmic phase of Azotobacter vinelandii were exposed to doses of 5, 25, and 40 kR of x radiation to determine the cellular radiation injury in vivo. The RNA was determined spectrophotometrically; the activating capacity of the pH 5 ferments was evaluated by means of a ^{32}P exchange reaction. It was found that exposure of the Azotobacter cells to high doses of x radiation results in the reduction of the compound (I), but low doses of the order of 5 kR have no effect or exert a slight activating action. (TTT)

22589 ENHANCEMENT OF THE AFTER EFFECT OF IONIZING RADIATION BY A CYTOTOXIC METHYLHYDRAZINE DERIVATIVE. Berneis, K.; Bollag, W.; Kofler, M.; Luethy, H. (F. Hoffman-La Roche and Co. Ltd., Basel. Lab. for Medical Radiation Physics, Burgerspital, Basel). Europe. J. Cancer, 2: 43-9(Feb. 1966).

The cytotoxic methylhydrazine derivative N-isopropyl-p-(2-methylhydrazino-methyl) benzamide hydrochloride (Natulan(R)) degrades DNA in solution by a similar mechanism to ionizing radiation. The combined treatment of DNA with α radiation and with Natulan(R) caused more double breaks of DNA molecules than would be expected from a simple summation of the effects of radiation and of the cytotoxic agent. The synergism between ionizing radiation and Natulan(R) was demonstrated by means of dose-effect curves. To obtain the greatest synergistic effect Natulan(R) was added immediately after termination of irradiation. No synergism was observed between irradiation and a cytotoxic compound of the alkylating type (nitrogen mustard). It is suggested that the unstable peroxide products formed during irradiation of DNA are responsible for the synergism between irradiation and Natulan(R). (auth)

22590 EFFECT OF ULTRAVIOLET IRRADIATION ON PROTEIN SYNTHESIS BY CHLOROPLAST RIBOSOMES. Biswas, Susweta; Biswas, B. B. (Bose Inst., Calcutta). Exp. Cell Res., 41: 682-5(Mar. 1966).

Results are reported from a study of the effect of uv irradiation on protein synthesis in ribosomes of chloroplasts isolated from spinach leaves. The effect of dimer formation on the inhibition of RNA synthesis or of amino acid incorporation into protein is discussed. Studies on isolated RNA particles indicated that messenger RNA is differentially affected by uv radiation. (C.H.)

22591 CHANGE IN THE BIOPHYSICAL PARAMETERS OF THE SURFACE LAYER OF THE PROTOPLASM OF MOLLUSK NEURONS UNDER THE EFFECT OF IONIZING RADIATION. Bogomoletz, V. I.; Maiskii, V. A. (Bogomoletz Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 12: 63-9(Jan.-Feb. 1966). (In Ukrainian).

Studies were conducted on the giant unipolar neurons of the parietal ganglia in Planorbis corneus. Rectangular current pulses were passed through one of two microelectrodes inserted into the nerve cell. Changes in transmembranic potential difference and action potentials were observed for three hrs postirradiation and were compared with the same electrophysiological parameters in nonirradiated controls. Large doses of x rays decreased both the rest potential and the action potential in giant unipolar neurons, the greater decrease being noted in the action potential. The specific resistance of neuron membranes was also decreased during the first three hrs after irradiation, but no definite change was detected in membrane capacity. (H.G.D.)

22592 CHANGE IN THE TIGROID SUBSTANCE OF NEURONS UNDER THE EFFECT OF RADIO WAVES. Bilokrinitskii, V. S. (Bogomoletz Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 12: 70-8(Jan.-Feb. 1966). (In Ukrainian).

A morphological investigation of the functionally different spinal and cerebral neurons was conducted in cats under the effect of large doses of radio waves (power flux density 0.4–0.5 w/cm^2). The animals were irradiated for one hour and sacrificed immediately afterwards. The material was investigated by Nissl's method. The tigroid substance was found to be in different states up to complete fusion in some neurons. Changes were found in the shape of the neurons and in the state, position, and tinctorial properties of the nuclei and nucleoli. The neurons were affected by radio waves to different degrees, depending on the functional properties of the neurons and their ontogeny. The degree of structural changes in the neurons during the action of a super high-frequency field on the organism may be a reliable criterion of the injurious effect of radio waves. (auth)

22593 CHROMATOGRAPHIC, SPECTROMETRIC, AND IRRADIATION BEHAVIOR OF FIVE CARBAMATE INSECTICIDES. Eberle, D. O.; Gunther, F. A. (Univ. of California, Riverside). J. Ass. Offic. Agr. Chem., 48: 927-37(Oct. 1965).

Various analytical techniques for the detection and determination of microgram quantities of five carbamate insecticides (carbaryl, Dimetilan, Isolan, Pyrolan, and Zectran) are compared. The insecticides, separated by thin-layer and gas chromatography, were quantitatively characterized through a combination of fluorescence, ir and uv spectrometry, and oscillographic polarography techniques. The chemical reactions resulting from the influence of natural sunlight and short-wavelength uv radiation on carbamate insecticides were followed by these microanalytical and instrumental methods. Dimetilan showed increasing amounts of three degradation products with increased exposure to uv radiation. One product was 3-methyl-5-hydroxy-pyrazol-5-dimethylcarbamate. Exposure to artificial and natural sunlight for 5 hr yielded the same decomposition products. Isolan, under the same conditions of irradiation, showed the formation of 1-isopropyl-3-methyl-pyrazolone and a second unknown degradation product. Pyrolan was degraded by short-wavelength uv radiation very rapidly. Thus, after 5 min 1-phenyl-3-methyl-pyrazolone became visible. Also, the ir spectrum of the exposed Pyrolan solution showed a decrease of the C=O carbonyl band at 1749 cm^{-1} and the formation of a new keto band at 1720 cm^{-1}, belonging to the pyrazolone. Carbaryl showed similar behavior. Short-wavelength uv radiation as well as artificial sunlight, after 3 hr, resulted in four products, including α-naphthol. Zectran behaved as previously reported. (BBB)

22594 BIOLOGICAL EFFECTS OF IONIZING RADIATION ON MILK SYNTHESIS. II. MILK PRODUCTION AND COMPOSITION. Luick, J. R. (Univ. of California, Davis). J. Dairy Sci., 48: 1618-22(Dec. 1965).

Changes in volume and chemical composition were examined in milk produced by x- and γ-irradiated cow and goat mammary glands. Exposures of 34 to 78 R were made with a 250-kvp x-ray machine; higher levels (150 to 2500 R) were administered with a specially designed ^{60}Co irradiator. Milk samples were taken at frequent intervals before and after irradiation for determination of chemical composition. Dose levels of less than 1000 R had no demonstrable effect on milk production or on per cent composition of fat, solids-not-fat, total solids, lactose, citrate, total nitrogen, nonprotein nitrogen, total phosphorus, inorganic phosphorus, chloride, ash, sodium, potassium, calcium, or magnesium. Exposure to 1000 R or more of γ irradiation, however, always inhibited milk production. The threshold dose was between 750 and 1000 R given as a single exposure and measured at the midplane of the udder. Since dose levels above the threshold level consistently depressed lactation and caused extensive radionecrosis of mammary epithelium, these results gave no support for the proposal that ionizing radiation be used to increase milk production. (BBB)

22595 EFFECT OF IRRADIATION DURING FETAL LIFE ON THE SUBSEQUENT STRUCTURE AND SECRETORY ACTIVITY OF THE GONADS. Beaumont, Heather M. (Univ. of Birmingham, Eng.). J. Endocrinol., 24: 325-39(June 1962).

Studies were undertaken to compare the response of the fetal gonad to irradiation with that of the gonads of immature and adult animals, and to correlate changes in secretory activity both with the developmental stage at the time of exposure and with postirradiation changes in the

structure of the organ. Female rats were exposed to doses of 100 R of acute x irradiation at 13.5, 15.5, 17.5, or 19.5 days of pregnancy. The offspring were killed at 25 to 120 days post partum. The results of quantitative studies of the population of germ cells confirmed that radiosensitivity of the germinal elements of the female fetus is maximal at 15.5 days of gestation. In contrast, the male germ cells become increasingly radiosensitive as pregnancy advances (17.5 to 19.5 days). The high radiosensitivity coincides with peak mitotic activity of oogonia, and sensitivity declines as the germ cells enter the prophase of meiosis (17.5 days onwards). Most irradiated ovaries secreted quantities of estrogen within the normal range for nonirradiated animals. The endocrine function of the testis is not affected by exposure to 100 R, a dose sufficient to cause almost complete elimination of germinal cells. (TCO)

22596 THE ULTRAVIOLET PHOTOCHEMISTRY OF CYTIDYLYL-(3′-5′)-CYTIDINE. Freeman, K. B.; Hariharan, P. V.; Johns, H. E. (Univ. of Toronto). J. Mol. Biol., 13: 833-48(Oct. 1965).

Ultraviolet irradiation of ^{32}P-labeled CpC (citidylyl-3′, 5′-cytidine) resulted in the production of two classes of photoproducts. One class, consisting of UpU, UpC, and U*pC (uridylyl-3′,5′-uridine, uridylyl-3′,5′-cytidine, and a hydrate of the latter compound, respectively) is stable and arises by spontaneous deamination and secondary photochemical action from the second class of photoproducts, which is unstable. The unstable class consists of CpC^1, CpC^2, UpC, C*pC and C*pC* (the superscripts 1 and 2 referring to dimers that were isolated). All the stable and unstable photoproducts were isolated by electrophoresis and chromatography and identified, and a reaction scheme was put forth to explain their production. The maximum yield of the dimer photoproducts depended markedly on the conditions of irradiation. The yields from CpC as measured by the amount of UpU produced were about five times higher at 280 mμ than at 240 mμ. The yields depended on pH during irradiation. For example, at 280 mμ the amount of UpU increased from 3 to 15% as the pH was increased from 3.0 to 7.0. UpC was not produced when the irradiation was carried out at 0°C but was formed if the CpC was irradiated at room temperature. Irradiation at room temperature allowed for some deamination of CpC to UpC during the irradiation, and the UpC was then converted to UpC by the irradiation. (BBB)

22597 REVERSAL AND DEAMINATION RATES OF THE MAIN ULTRAVIOLET PHOTOPRODUCT OF CYTIDYLIC ACID. Johns, H. E.; LeBlanc, J. C.; Freeman, K. B. (Univ. of Toronto). J. Mol. Biol., 13: 849-61(Oct. 1965).

3′-Cytidylic acid (Cp) was uv irradiated to produce, as the main photoproduct, C*p. The absorption spectrum of C*p has maxima at 240 and 210 mμ and a pK of 5.56. It can be separated from Cp by rapid high-voltage electrophoresis (20 min 0°C at pH 4.4). The separated C*p reverses to Cp and deaminate to U*p (water addition photoproduct of 3′-uridylic acid, Up). The rate constants for reversal and deamination were measured at 6, 15, and 25°C over a pH range from 3 to 10. The reversal rate constant was maximum at pH 5.0 with a value of 1.6×10^{-2} min^{-1} at 25°C. The corresponding deamination rate constant was 4.0×10^{-4} min^{-1}. The maximum amount of U*p, which could be recovered from C*p was independent of temperature and varied from 2.5 to 14% over the pH range, with the minimum value at pH 5.0. The experiments provided good evidence that the photoproduct C*p is the water adduct of Cp. The implications of these findings on code changes in RNA and DNA are discussed. Irradiation of DNA or RNA may lead to at least four types of damage to the cytosine base. These are C*p, U*p, Up, and a number of types of dimers between cytosine and any one of cytosine, thymine, or uracil. The coding properties of the hydrates can be considered as a function of time after irradiation. If replication occurs immediately after the damage, only C*p is involved in producing an error. After about two hr, about 8% of the C*p is converted to U*p and the rest back to Cp. After a few days, the prevalent type of damage is the replacement of C by U. (BBB)

22598 BIOCHEMICAL STUDIES ON IRRADIATED PROTOZOA. III. CATALASE ACTIVITY IN TETRAHYMENA PYRIFORMIS W. Roth, Jay S.; Buccino, Gayla (Univ. of Connecticut, Storrs). J. Protozool., 12: 432-7 (Aug. 1965).

Experiments were directed to determine the cause of protozoan radioresistance. The catalase activity of Tetrahymena pyriformis W was examined, and the radioresistance of the protozoa tested under conditions where the activity or synthesis of catalase was inhibited. The effect of catalase inhibitors on the growth, respiration and enzyme activity of the protozoa was investigated. Allylisopropylacetamide (AIPA), rendered the protozoa more sensitive to irradiation with 500,000 R of γ rays. The effect of catalase inhibitors on the respiration of Tetrahymena was studied. 3-Amino-1,2,4-triazole (AT) was an active specific inhibitor for catalase activity in vitro or in vivo, while AIPA prevented its synthesis. When ^{32}P was added at levels up to 50 μC/ml, it had no significant effect on the growth rate, and protozoa growing in this concentration of ^{32}P for a week showed no significant gross abnormalities at the end of this time. Cells growing in the presence of AIPA and AT were irradiated at 500,000 R/hr. Irradiation caused a 72-hr lag in growth that was considerably extended by increasing concentrations of AIPA and AT. At the highest concentration used, a synergistic effect was noted. The catalase activity of the total particulate material obtained from cells grown in the presence of 0.008M AIPA for 3 days was not significantly different from that of controls. Therefore, the increased radiosensitivity of Tetrahymena grown in the presence of AIPA may result from some factor other than changes in catalase activity. (TCO)

22599 PRODUCTION OF ADDITIONAL SITES OF DEOXYRIBONUCLEIC ACID BREAKDOWN IN BROMOURACIL CONTAINING ESCHERICHIA COLI EXPOSED TO ULTRA-VIOLET LIGHT. Boyce, Richard P. (Yale Univ., New Haven). Nature, 209: 688-91(Feb. 12, 1966).

Investigations supporting the interpretation that sensitization of bacteria to radiation resulting from the incorporation of BU into their DNA is due to an enhancement of DNA breakdown and failure to synthesize DNA are reported. The results also indicate that in uvr$^-$ mutants ultraviolet light causes strand breakage in DNA containing BU, whereas mitomycin C does not. (auth)

22600 TWO-COMPONENT RADIATION EFFECT ON ^{85}Sr ABSORPTION BY THE RAT ILEUM IN SITU. Marcus, C. Silber; Vos, O. (RVO-TNO, Rijswijk, Netherlands). Proc. Soc. Exp. Biol. Med., 121: 885-8(Mar. 1966).

Male Wistar rats (150 to 180 g) were exposed to 0, 695, 926, and 1158 R whole body x irradiation and tested for changes in ^{85}Sr absorption 1, 2, 3, and 4 days after irradiation by injecting a ^{85}Sr solution into ligated ileal sacs in situ and recovering the unabsorbed dose 3 hours later. A 2-component radiation effect was described. Two days after 695 R, the rats showed a significant decrease in absorption followed by a return to the control level within 2 more days. Three days after 926 R, there was a significant increase in ^{85}Sr absorption; those that survived to 4 days showed a trend back to the control level. Three days after 1158 R, there was a highly significant increase in absorption; no rats survived beyond 3 days. ^{91}Y, which is not at all absorbed by the normal intestine, is also not absorbed by 695 R rats 2 days after irradiation or 1158 R rats 3 days after irradiation. (auth)

22601 FREE RADICAL CONCENTRATION IN IRRADIATED BACTERIAL SPORES AND VEGETATIVE CELLS AS MEASURED BY THE ESR METHOD. Tanooka, Hiroshi (Japan Atomic Energy Research Inst., Tokyo). Radiat. Res., 27: 570-81(Apr. 1966).

Radiation-produced free radicals in dry spores and vegetative cells were studied by the ESR method. In B. subtilis spores, the radical concentration reached the saturation level around 5 Mrads. The effect of the anoxic heat treatment applied after α irradiation was most clearly shown in the decay pattern of the radicals. Irradiation in the presence of oxygen considerably decreased the radi-

cal concentration. In vegetative cells, on the other hand, a different pattern of the behavior of radicals was observed including a different ESR spectrum, less radical-producing efficiency, and no heat effect on the decay pattern of radicals. Correlation of these ESR data with biological observations is discussed. (auth)

22602 THE EFFECTS OF DAMAGED PROTEIN ON THE LIGHT-SCATTERING PROPERTIES OF RNA SOLUTIONS: A COMPARISON OF THERMAL AND RADIATION EFFECTS. Mullaney, Paul F.; Preiss, John W. (Univ. of Delaware, Newark). Radiat. Res., 27: 582-96(Apr. 1966).

Thermal experiments conducted with dry proteins in vacuo indicate that these proteins will increase the turbidity of RNA solutions as a nonmonotonic function of the exposure time. The results are similar to those observed for the same proteins subjected to electron bombardment. A number of combination heating and radiation runs were made, producing a shift in the turbidity peaks, as observed when the excess turbidity was plotted as a function of the parameter measuring the last agent applied. These effects are explained with a statistical model describing the produced effect in terms of a distribution of the molecules among a number of possible states of damage. The results strongly suggest that heating and radiation produce very similar types of damage at the molecular level. (auth)

22603 PRODUCTION OF FREE RADICALS IN SOLID BIOLOGICAL SUBSTANCES BY HEAVY IONS. Henriksen, Thormod (Univ. of California, Berkeley. Norsk Hydro's Inst. for Cancer Research, Montebello, Norway). Radiat. Res., 27: 676-93(Apr. 1966). (UCRL-16280).

Several biochemicals, including amino acids, peptides, proteins, and nucleic acid components, were exposed to a large variety of radiations, and the production of secondary radicals was studied. The substances were irradiated at room temperature with 6.5-Mev electrons and fast stripped helium, lithium, boron, carbon, oxygen, fluorine, neon, silicon, and argon ions from the Berkeley heavy-ion linear accelerator. From the recorded ESR spectra it appears that the types of secondary radicals were independent of the stopping power of the radiation. On the other hand, the relative yields of the primary ESR centers seem to be influenced by the type of radiation. The yield of secondary radicals was independent of the stopping power up to about 200 Mev gm^{-1} cm^2. At higher values the yield decreased with increasing stopping power. The total variation within the LET range studied (up to 1.6×10^4 Mev gm^{-1} cm^2) was by a factor of 2 to 5 for the different substances. The yield-versus-stopping power curves exhibit the same form as that found for the inactivation of solid enzymes and T1 bacteriophage. This observation supports the idea that the observable damage to solid biological systems is the end result of a sequence of events in which free radicals are important intermediates. A model for the production of the secondary radicals by heavy ions is proposed. The radicals produced along the track are assumed to be the sum of those produced in the radical track core and those produced by the δ-rays outside the track core. When the stopping power of the ion increases, the density of radicals in the track will reach the saturation level, first in the core and then gradually also outside the core. Consequently, an increasing region around the center of the track will be saturated with radicals, and only that portion of the δ-ray energy dissipated outside this region will be available for production of additional radicals. On the basis of the δ-ray spectrum it is possible to calculate a curve for the number of radicals along the track versus the stopping power of the bombarding particle. The expected curve for glycine is in good agreement with the experimental results. (auth)

22604 EFFECT OF IRRADIATION TEMPERATURE ON PRODUCTION OF FREE RADICALS IN SOLID BIOLOGICAL COMPOUNDS EXPOSED TO VARIOUS IONIZING RADIATIONS. Henriksen, Thormod (Univ. of California, Berkeley. Norsk Hydro's Inst. for Cancer Research, Montebello, Norway). Radiat. Res., 27: 694-709(Apr. 1966). (UCRL-16281).

The effect of the irradiation temperature on the production of secondary free radicals in glycine, trypsin, and lysozyme was studied. The solid compounds were irradiated in vacuum, with fast stripped helium, carbon, and argon ions at different temperatures in the range 77 to 320°K. The number of secondary radicals was measured with an ESR spectrometer after the samples had been kept at room temperature for 20 minutes. It was found that the radical yield was independent of the irradiation temperature up to 100 to 120°K. At higher levels the yield increased, and in the temperature range 77 to 295°K the total variation averaged a factor of 2.2. This variation is assumed to be due to a temperature effect on the radical reactions that take place during irradiation. It was found that the yield-versus-temperature curves could be adequately described by a sum of exponential functions. The experiments on trypsin showed a good correlation between the production of secondary radicals and the loss of enzymatic activity when the irradiation temperature varies. Similarly, a good correlation was found in experiments in which the stopping power of the radiation varied. Based on these results, a model for the inactivation of solid enzymes has been proposed. It is assumed that the loss of enzymatic activity is the result of a sequence of events in which free radicals are important intermediates. (auth)

22605 EFFECT OF IONIZING RADIATION AND CERTAIN RADIOMIMETICS UPON THE DISTRIBUTION OF ^{32}P IN THE ORGANISM. Costachel, O.; Voiculet, N.; Tautu, P.; Kiraleu, F. (Oncological Inst., Budapest). Radiobiol.-Radiotherap., 3: 471-9(1962). (In French).

Rats were irradiated with 325 R of x ray or given radiomimetic drugs intraperitoneally, and 24 hr later injected intravenously with ^{32}P. The urinary excretion of the ^{32}P was increased while at the same time the amounts in liver and other tissues were decreased. It is believed that the differences observed were due in part to the inability of the administered P to establish dynamic equilibrium with the cellular P. The similarity between the effects of the irradiation and the radiomimetic agents administered was in agreement with previous reports from studies of effects of irradiation and alkylating agents on tumors. (BBB)

22606 ACTION OF γ RAYS UPON THE GERMINATIVE AND ENZYMATIC ACTIVITY OF PISUM SATIVUM L. SEEDS. Sosa-Bourdouil, C. (Institut du Radium, Paris). Rev. Gen. Bot., 68: 653-71(1961). (In French).

The effects of ^{60}Co γ irradiation on germinating Pisum sativum seeds were measured by the amount of ^{32}P incorporated. The maximum incorporation was observed in both gemmules and radicules after 3 days incubation. Compared to nonirradiated samples, incorporation was reduced by ~70 and 80% in seeds exposed to 7×10^5 and 10^6 R, respectively. Incorporation of ^{32}P by the gemmule was related to the degree of development and was much less than by the radicule. The cotyledons incorporated very little ^{32}P. Incorporation of ^{32}P was less when seeds in a more advanced stage of germination were incubated with the ^{32}P. The degree of incorporation tended to decrease following irradiation with from 2×10^4 to 10^6 R. Activities of the enzymes phosphatase, amylophosphorylase, and the glutamyltransferase-synthetase system extracted from the seeds were measured after irradiation with from 7000 to 10^8 R. Phosphatase activity decreased to 28% of its original value, but did not start to decrease until a dose of 10^6 R was given. Amylophosphorylase activity started to decrease at ~10^5 R and reached a value of 8% at 10^7 R. The glutamyltransferase activity decreased to 33% of its original value at ~2.5×10^7 R. (BBB)

22607 SOME DETAILS OF THE DISTURBANCE IN THE METABOLISM OF PROTEINS IN AN ANIMAL UNDER THE INFLUENCE OF IONIZING RADIATION. Graievskaia, B. Tr. Inst. Genet. Akad. Nauk SSSR, No. 32, 94-118(1965). (In Russian).

It was shown that whole-body x irradiation (600 R) causes in mice an increase of protease activity after 24 hr in extracts of spleen and after 96 hr in extracts of liver. The protease activity was determined by the extracts' capacity to hydrolyze casein. After local irradiation of the spleen with shielding of the rest of the body or irradiation of

spleen in vitro, the protease activity of extracts does not increase. A direct relation was noted between the protease activity increase in the spleen and the degree of tissue injury. After irradiation, the protease activity in spleen was increased later than the appearance of necrobiotic changes. Treatment with AET and cystamine reduced the radiation effect on spleen protease activity, but carbon monoxide was not effective in preventing this response. A direct relation appears to exist between the degree of radiosensitivity of different species animals (also of some strains) and increased protease activity of the spleen. (BBB)

22608 EVIDENCE OF DIFFERENT MECHANISMS FOR ULTRAVIOLET REACTIVATION AND ORDINARY HOST CELL REACTIVATION OF PHAGE λ. Kneser, H.; Metzger, K.; Sauerbier, W. (Univ., Cologne). Virology, 27: 213-21 (Oct. 1965).

Whether uv-reaction (UVR) of phage λ is uv-stimulated host cell reactivation (HCR) was reexamined by methods inhibiting HCR. Even when ordinary HCR was blocked by simultaneously using caffeine, K12 hcr⁻ hosts, and 5 Bu-λ, UVR could not be abolished. It is concluded that ordinary HCR and UVR are achieved by (at least partially) different mechanisms of repair. Experimental evidence against the participation of nucleases in UVR was also obtained. (TCO)

22609 HOST-CONTROLLED MODIFICATION. Klein, A. (Univ., Cologne). Z. Vererbungsl., 96: 324-45(1965). (In German).

The phenomena and effects of host-controlled modification (HCM) as described in the literature are comprehensively discussed. The review includes the occurrence of HCM in E. coli and other bacteria, the restriction and modification caused by HCM, its influence on bacterial and phage crosses, and the function of restricted genes. The genetic control of HCM and mutual effects of HCM and mutual effects of HCM and uv-irradiation are reviewed. (tr-auth)

Radiation Effects on Tissues

22610 (AD-632049) ^{59}Fe INCORPORATION INTO SPLEEN AND BONE MARROW OF INTACT AND SPLENECTOMIZED X-IRRADIATED MICE RESTORED WITH SPLEEN COLONY CELLS. Schofield, R.; Cole, L. J. (Naval Radiological Defense Lab., San Francisco, Calif.). Mar. 11, 1966. 11p. (USNRDL-TR-989). CFSTI $1.00 cy, $0.50 mn.

Cells from hemopoietic tissues when injected into lethally-irradiated mice induce survival and restoration of the animals, whether they are intact or splenectomized. But cells derived from hemopoietic nodules (that occur in spleens of heavily irradiated mice injected with bone marrow cells) when injected into lethally irradiated mice result in different effects in intact mice than in splenectomized ones. In the former the anemia resulting from irradiation is corrected within 25 days, whereas in splenectomized mice the anemia that develops is much more severe and persists for up to 80 days after irradiation. The course of cellular repopulation of bone marrow in splenectomized mice irradiated with 900 rad and injected with spleen-nodule cells was compared with that in intact mice treated in the same way. The method used was that of the uptake in femora of ^{59}Fe at 5 hours after an injected dose. No differences were seen, indicating that the absence of the spleen did not have an effect on the repopulation. However, by comparing the results with those obtained similarly in irradiated mice injected with either bone marrow cells or normal spleen cells and also with irradiated mice which received no cell injection, it appears that spleen nodule cells do not assist in the repopulation of bone marrow with erythroid cells. In order to assess the erythropoietic activity of total body bone marrow, to enable this to be compared with the erythropoietic activity of spleen, determination of ^{59}Fe in whole cleaned mouse skeletons was carried out. The results show that in the mouse the two femora account for 13-15% of the total skeletal content of ^{59}Fe at 5 hours after injection of the label. (auth)

22611 (CEA-R-2874) ACTION DE 50 R DE RAYONS X SUR LA FONCTION DE REPRODUCTION DES SOURIS DE RACE C3H. INFLUENCE DU FRACTIONNEMENT; ACTION DE LA REPETITION DES IRRADIATIONS AU COURS DES GENERATIONS SUCCESSIVES. (Action of 50 R X-Ray Doses on the Reproductive Function of C3H Strain Mice. Effect of Fractionation; Action of Repeated Irradiation on Successive Generations). Allx, Denise (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Dec. 1965. 24p. Dep. mn.

The effects of x radiation on reproduction of mice were studied. Animals were exposed to single doses of 20, 30, 40, and 50 R; and fractional doses of 50 R/total dose divided into 2, 5, 10, or 25 irradiations distributed over one month duration. The offsprings were irradiated at the same doses as the parents, consanguinity being maintained. Statistical treatment of results was carried out. Results indicated that couples receiving a single exposure of 50 R or two exposures of 25 R at one month intervals gave comparable results. Fractional doses did not produce the slightest diminution of x ray effect; 30 R exposure brought about a decrease in fertility, with an increase in abortions. Fertility of 20 R irradiated couples remained below controls. After ten times 5 R and twenty-five times 2 R, the number of abortions was the largest. Ovarian function is particularly sensitive to x rays; one may think that twenty-five 2 R doses give injuries conditioning non-viability of conception products, and smaller doses should produce mutations and yield births of altered genotype individuals. (auth)

22612 (COO-1404-3) DIPLONTIC SELECTION AND ITS MODIFICATION BY GAMMA RADIATION IN A COLCHICINE-TREATED GRASS HYBRID. 2. COMPARATIVE RADIOSENSITIVITY STUDIES IN THE GRAMINEAE (PROPOSED). Progress Report, 1964-1965. Boyle, William S. (Utah Univ., Salt Lake City). Contract AT(11-1)-1404. 28p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Progress is reported on studies on the effects of γ radiation on growth and diplontic selection in cholchine-treated hybrids of grass Agropyron cristatum and A. subsecundum. The average interphase chromosome volumes for A. cristatum and A. subsecundum were calculated with a karyotype analysis was made of the natural triploid hybrid between the Agropyron species that would permit an evaluation of the relation of total chromosome length to radiosensitivity. The data led to the conclusion that total chromosome length is not useful in predicting radiosensitivity. (C.H.)

22613 (NIRS-4, pp 21-8) BIOLOGICAL STUDIES: BIOCHEMISTRY AND BIOPHYSICS. (National Inst. of Radiological Sciences, Chiba (Japan)).

A mathematical model for the pathology of radiation injuries in mammals as a function of time is presented. Results are summarized for studies on the inactivation of transforming DNA from Diplococcus pneumoniae by x radiation as revealed by ultraviolet flow dichroism; the use of antiphage serum for the determination of bacteriophage-specific proteins in E. coli; the localization of free radicals induced by γ radiation in dry Artemia eggs; protein synthesis in isolated rat liver mitochondria in glycerol suspension; the effects of γ radiation on the activation of the succinoxidase system in glycerinated mitochondria by ATP; and the content of 20 α-hydroxysteroid dehydrogenase in x irradiated rat testes. (C.H.)

22614 (NIRS-4, pp 28-34) BIOLOGICAL STUDIES: CYTOLOGY AND MORPHOLOGY. (National Inst. of Radiological Sciences, Chiba (Japan)).

Results are summarized from cytological studies of the x radiosensitivity of spermatogonia of silkworm; the restitution of x radioinduced chromosomal damage in human leukocytes in culture; the physiological reaction of fish melanophores to x radiation; cytological studies of the effects of 1,000 R whole-body x radiation on mouse spleen; and the effects of 175, 200, or 400 R x radiation doses on the development of mouse embryos. (C.H.)

22615 (NIRS–4, pp 34–58) BIOLOGICAL STUDIES: PHYSIOLOGY. (National Inst. of Radiological Sciences, Chiba (Japan)).

Results are summarized from kinetic studies of recovery processes in x irradiated HeLa cells; the lethal effects of x radiation on rat thymocytes exposed in vitro and in vivo; the effects of x radiation on ^{3}H-thymidine uptake in the intestinal epithelium of goldfish, Carassius auratus, at different temperatures; the lethal effects of a massive dose of ^{60}Co γ rays delivered to the head of goldfish; the relation of thyroid activity and Na excretion to radiosensitivity of goldfish; the effect of temperature on the x radiosensitivity of the cold-blooded fish, Oryzias latipes, the effects of x radiation exposure of the head of rats on enzyme activity in the testes; the effects of x radiation or repeated bleedings on the serotonin content of rabbit blood; the effects of x radiation on the body weight and survival rate of mice; the effects of x radiation on spontaneous and evoked electrical activity in rabbit brains; the effects of x radiation on immune reactions of mice to injected bone marrow; and the relation between oxygen consumption and radiosensitivity of mouse tissues. (C.H.)

22616 (NIRS–4, pp 58–69) BIOLOGICAL STUDIES: GENETICS. (National Inst. of Radiological Sciences, Chiba (Japan)).

Results are summarized from studies of mechanisms involved in the photodynamic inactivation of bacteriophage; the mechanism of radioinduced mitotic recombination in yeast exposed to uv and x radiations and C and He charged ions; the mutagenic effects of massive acute x radiation doses in Drosophila melanogaster; a comparison of the mutagenic and lethal effects of x radiation in silkworms; the effects of penicillin on x radioinduced mutations in Drosophila melanogaster; the effects of temperature on the frequencies of deleterious genes in a population of Drosophila melanogaster; the genetic effects of x radiation in a population of Drosophila melanogaster; and the distribution of blood group frequencies and genetic structure in a Japanese population. (C.H.)

22617 (RLO-1780-1) EFFECTS OF IONIZING RADIATION ON THE TESTICULAR FUNCTION OF MAN. Third Yearly Progress Report, June 1, 1965–May 31, 1966. Heller, Carl G. (Pacific Northwest Research Foundation, Seattle, Wash.). Feb. 1966. Contract AT(45-1)-1780. 78p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Preliminary data from a study of the effects of x radiation on the testicular function of man indicate that the human system is more sensitive than other mammals for which data are available. The design and calibration of x-ray equipment to deliver a uniform dose to both testes of human beings are discussed. Data are included on the effects of x radiation doses ranging from 5 R to 600 R total urinary gonadotropins, interstitial cell stimulating hormone, 17-ketosteroids, total estrogens, urinary testosterone, seminal fluid, sperm morphology, germinal epithelium, and spermatogenesis. The timing of spermatogenesis was confirmed, and the effects of various doses of x radiation on chromosomes were determined. The quantitation of biopsy specimens is discussed. (C.H.)

22618 (RT-BIO-(65)31) ON THE RELATIONSHIP BETWEEN RADIATION RESISTANCE AND RECUPERATION ABILITY OF ARTEMIA SALINA OOCYTES. Metalli, P.; Ballardin, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov. 1965. 10p. (CONF-650968–1). Dep. mn.

From European Society for Radiation Biology, Section on Genetical Effects, Annual Meeting, Utrecht.

X-ray-induced dominant (total embryonic) lethality in oocytes of Artemia salina shows dose-action curves with a shoulder followed by a nearly exponential relationship at high doses. It was found that the tetraploid oocytes are more radioresistant than the diploid ones, as evidenced by a slope ratio of 3 to 4. Further, the threshold is about twice as large and it was suggested that part of the damage could be repaired in all strains and that the tetraploid oocytes might enjoy a greater recuperation efficiency, besides being more resistant. This hypothesis was tested with the split-dose technique on diakinesis (or prometaphase) oocytes, which is a stage of long duration and constant peak radioresistance in all strains. The results show that only part of the damage is repairable, and the recuperation efficiency is the same for all strains, and therefore is not correlated with radioresistance. The absolute amount that a cell can repair, as estimated by the size of the conditioning dose is strictly proportional to the shoulder width and independent of the extrapolation number and the sensitivity. The time required to reach maximum recovery is strain dependent: 15 min to 1 hr in diploids, 4 hr in tetraploids. (auth)

22619 (SRS–307) A SEARCH FOR GENETIC EFFECTS OF HIGH NATURAL RADIOACTIVITY IN SOUTH INDIA. Grueneberg, H.; Bains, G. S.; Berry, R. J.; Riles, Linda; Smith, C. A. B.; Weiss, R. A. (Medical Research Council, London (England)). Nov. 1965. 63p. Dep. mn. BIS $2.20. HMSO 11s. 0d.

The coastal area between Neendakara and Kayankulam, north of Quilon in Kerala, South India, (which is effectively an island) has high natural radioactivity owing to the presence of monazite sand, which contains thorium. The mean gamma radiation on the strip is about seven-and-a-half times that of the control areas inland. The strip has been inhabited and geographically isolated for a very long period. A search for genetic damage was made in rats (Rattus rattus L) inhabiting this area. The material examined included the macerated skeletons and teeth of 438 rats from eight localities on the strip and of 458 rats from eight control localities inland. In addition, data were collected from these animals on fertility and embryonic mortality. No evidence was found that variance was greater in the irradiated than in the control populations. Possible explanations are discussed. (C.H.)

22620 (TID–22823) THE SELECTIVE DESTRUCTION OF MICRONEURONS BY LOW-DOSE IRRADIATION. Annual Progress Report and Renewal Proposal with Revised Budget Estimate, Supplement I. (Massachusetts Inst. of Tech., Cambridge). [1964]. Contract AT(30-1)-3045. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The multiplying and differentiating cells of the body are highly susceptible to the effects of ionizing radiation. It may be expected, therefore, that the postnatally-forming microneurons and glia cells would be selectively destroyed by exposure to low-level γ or x irradiation. Evidence from the literature is briefly reviewed which is in agreement with this expectation. We plan to undertake experiments in which irradiation of the head (and of specific brain regions, e.g., cerebellum, hippocampus) will be combined with thymidine-^{3}H injection in order to determine quantitatively the effect of radiation on the newly-formed, migrating and differentiating cells. This technique of selective extirpation in surviving animals, moreover, will enable us to study the role of microneurons in the organization of behavior. (36 references). (auth)

22621 (TID–22842) THE LETHAL EFFECTS OF ^{60}Co ON MATURE CHICKENS. Final Report. Banks, W. C. (Texas Agricultural Experiment Station, College Station). [1966]. Contract AT(40-1)-2946. 70p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Twelve mature female chickens were exposed for 25 hr to a total dose of 1250 R γ radiation at a rate of 50 R/hr. Data are presented on the effects of radiation on the blood picture, gross weight, and egg production. Data are also included from a study of the effects of 800 R γ radiation distributed over periods of 24 to 96 hr on economic traits of male and female chickens. It was concluded that the $LD_{50/30}$ for mature chickens is less than 1250 R. (C.H.)

22622 (AD–625779) EARLY DIAGNOSIS OF ACUTE RADIATION SICKNESS. Selected Articles. Ledanova, S. N. (ed.). Translated from pp 1–4; 16–28; 62–94; 103–39; 147–68; 174–232 of K Voprosam Ranney Diagnostiki Ostroy Luchevoi Bolezni, Kharkov Inst. of Medical Radiology, Kiev, 1962. 244p. (FTD-TT-65-589). CFSTI.

Results are reported from 18 studies on early biochemical, morphological and physiological changes observed in

rabbits and rats after exposure to doses of x radiation ranging from 200 to 800 R. Data are included on changes in blood proteins, metabolism, blood coagulation, the peripheral blood picture, gastrointestinal function, the nervous system, and the function of the adrenal glands. Applications of the data in the early diagnosis of radiation injuries are discussed. The performance of proportional detectors for use in the dosimetry of x radiation is also discussed. (C.H.)

22623 (UCRL-Trans-1232) COMBINED EFFECT OF SPACE-FLIGHT FACTORS ON CERTAIN FUNCTIONS OF AN ORGANISM. Frank, G. M.; Livshits, N. N.; Arsen'eva, M. A.; Apanasenko, Z. I.; Belyaeva, L. A.; Golovkina, A. V.; Klimovitskii, V. Ya.; Kuznetsova, M. A.; Luk'yanova, L. D.; Meyzerov, E. S. Translated for Lawrence Radiation Lab., Univ. of California, Berkeley, from Paper Presented at the 2nd International Symposium on Basic Environmental Problems of Man in Space, Paris, 1965. 82p. (CONF-650668-3). Dep. mn. CFSTI $3.00 cy, $0.75 mn. JCL $8.10 fs, $2.66 mf.

The results of studies of the effects of space flight conditions, including acceleration, vibration, ionizing radiation, and combinations thereof, on physiological functions, oxidizing metabolism in the central nervous system, and cell division in hematopoietic tissues in guinea pigs, mice, rabbits, and rats exposed to simulated conditions on the ground and during the flight of satellites, led to the conclusion that the different physiological changes that occur under the influence of acceleration or vibration result in a number of disturbances of cell division and that this in turn can alter the radiation effect. The diversity and complexity of a combined exposure to dynamic factors and irradiation are discussed. (55 references.) (C.H.)

22624 CHROMOSOMAL ALTERATIONS IN LEUKOCYTES INDUCED IN CHILDREN BY DIAGNOSTIC IRRADIATION (PRELIMINARY NOTE). Massimo, L.; Vianello, M. G.; Dagna-Bricarelli, F. (Univ., Genoa). Acta Genet. Med. Gemellol., 14: 282-94(July 1965). (In Italian).

Leukocyte cultures were prepared, and examined histologically, after 10 children aged 3 to 14 yr were exposed to x rays for diagnosis of various disorders. Multiple exposures were required and doses varied from 1.2 to 20.5 R. The number of cells showing transient chromosomal anomalies varied from 4 to 81% of the cells examined, compared with an average of 3.6% in nonirradiated controls. Polyploidy was noted in 0.9 to 19.5% of the cells, compared with 0.4% in controls. Thus a relatively high rate of chromosomal morphologic alterations in leukocyte cultures was seen in these 10 children who had previously undergone x irradiation for diagnostic purposes. The temporary alterations observed included achromatic lesions of one or more chromatids; fragmentation of chromatids, fragments without centromere, deletions, ring chromosomes, dicentric and tricentric chromosomes, and, in some cases, increase of polyploid mitoses. Some changes were noted more than a year after x-ray exposure. (BBB)

22625 ELECTRON MICROSCOPIC STUDIES ON BONE MARROW MEGAKARYOCYTES AND THROMBOCYTES IN NORMAL AND X-IRRADIATED ALBINO RATS. Hando, Tamotsu (Niigata Univ., Japan). Acta Haematol. Jap., 28: 38-45(Feb. 1965). (In Japanese).

Adult female Wistar rats were exposed to 800 R in a single total-body irradiation, and the bone marrow cells of their femora were examined electron microscopically before and after irradiation. Thrombocytes are demarcated, as Yamada (1957) described, by linear arrangement of the platelet demarcation vesicles. In the younger form of megakaryocyte, rough-surfaced endoplasmic reticulums often store in their cisterna homogenous involvement of moderate density that may become thrombocyte granules afterward. The megakaryocyte and thrombocyte show more and more conspicuous vacuolar changes of the intracytoplasmic membrane systems as time goes on after irradiation. In megakaryocytes these changes are the main cause of thrombocytopenia giving rise to vacuolar change and irregular arrangement of the platelet demarcation vesicles. In thrombocytes, they group themselves and centering of the platelet granules occurs. These phenomena are similar to those seen in viscous metamorphosis and may be one of the defense mechanisms against the hemorrhagic tendency caused by thrombocytopenia. Three and five days after irradiation electron lucent granules are observed in mast cells. This is considered to be one of the causes of hyperheparinemia. (auth)

22626 THE EFFECT OF RADIATION ON DNA SYNTHESIS IN BLOOD CELLS. AN ANALYSIS OF DNA SYNTHESIS CURVES IN NORMAL AND IRRADIATED BLOOD CELLS. Miyoshi, Kazuo; Kono, Hisayuki (Tokushima Univ., Japan). Acta Haematol. Jap., 28: 319-28(June 1965). (In Japanese).

Smeared preparations of blood cells were made from the femoral bone marrow of dd mice 3, 6, 12, 24, 48, and 72 hours after whole-body exposure of the animals to 1,000 R irradiation with ^{60}Co γ rays. The preparations were stained with Feulgen stain, and a quantitative determination of DNA content per cell was carried out by monochrome microspectrophotometric analysis. DNA determination was carried out in each kind of cells such as granular immature cells, lymphocytes, and erythroblasts. The results obtained in the granular immature cells are described and discussed in detail. The DNA content of each cell was plotted on a graph in the order of its quantity (from the minimum to the maximum), and this was assumed to represent the DNA synthesis curve in the given cellular system. Each curve was divided into three phases, G_1, S, and G_2, and the ratio of each phase was determined. This ratio represents the cell cycle in DNA synthesis. This ratio was corrected by the mitotic index (M) obtained in Giemsa stained preparations. The corrected ratio was 70.0%, 18.8%, 8.9%, and 1.6% for G_1, S, G_2, and M phases respectively. The fluctuation of the ratio after the irradiation is described. (TCO)

22627 HEMATOLOGIC CHANGES PRODUCED BY TELECOBALTHERAPY. Gayarre, C. Gil; Gayarre, M. Gil; Arenas, I. (Clinica de Medicina Fisica San Francisco Javier, Madrid). Acta Iber. Radiol.-Cancerol., 18: 49-52(Jan.-Mar. 1963). (In Spanish).

Changes in counts of circulating leukocytes and erythrocytes and in erythrocyte sedimentation rate were followed in 92 patients undergoing ^{60}Co irradiation for malignancies. Circulating erythrocyte counts began to decrease when total tumor doses of ~3000 rad were accumulated by the patients. Minimal red cell counts were reached when fractionated radiation doses totaled 4000 to 5000 rad. Circulating leukocyte counts rose slightly above basal values after total doses of 3000 to 4000 rad were reached, then fell sharply at ~5000 rad, and, after a minimum value at 6000 rad, rose gradually with increasing treatment. Factors affecting changes in hematologic parameters are discussed, and it is concluded that improvement in the patient's condition was responsible for the salutary changes observed. (TCO)

22628 LASER IRRADIANCE LEVELS FOR RETINAL LESIONS. Bergqvist, Tore; Kleman, Bengt; Tengroth, Bjoern (Research Inst. of the National Defence, Stockholm). Acta Ophthalmol., 43: 331-49(1965).

The action of laser radiation on rabbit eyes has been studied with four different ruby lasers and two Nd-glass lasers. The output of the lasers varied from a burst of pulses with a duration of 650 μsec to a single pulse of 35 nsec. It was found that with these lasers of widely different output characteristics there is a common threshold value in the peak irradiance at which lesions occur. The threshold value for the peak corneal irradiance is about 6 kw/cm^2 when the rabbit's eye is in the direct beam at a short distance from the laser. Results are in good agreement with the results from a few cases of irradiation of human eyes. Various aspects of hazards of laser radiation to the human eye are considered and safety measures are suggested for range finder operators. (TCO)

22629 OCULAR EFFECTS OF LASER RADIATION. PART I. Ham, William T. Jr.; Williams, R. C.; Mueller,

Harold A.; Ruffin, R. S.; Schmidt, F. H.; Clarke, A. M.; Vos, J. J.; Geeraets, Walter J. (Medical Coll. of Virginia, Richmond). Acta Ophthalmol., 43: 390-409(1965).

A review of the effects of laser radiation on the mammalian retina shows that there is a fundamental difference in the physical phenomena and biological consequences accompanying exposure of the retina to high density beams (Mw/cm^2 from Q-switched lasers) as compared to moderate power density beams (kw/cm^2 from normal laser pulses and pulsed xenon lamps). A radiation dose of ~0.07 J/cm^2 produces irreversible damage to the rabbit retina from a Q-switched ruby laser (exposure time 30 nsec), whereas ~0.85 J/cm^2 is needed to produce ophthalmoscopically visible damage from a laser pulse lasting for 200 μsec or longer. No definite physical or biological differences between ruby laser pulses and pulsed white light sources of comparable power density were detected for minimal damage to the rabbit retina. Both types of exposure can be explained adequately in terms of thermal injury using a simplified physical model and the classical law of heat conduction. Ophthalmoscopically visible damage to the rabbit retina for exposure times ranging from 200 μsec to 20 msec requires a remarkably uniform temperature in the pigment epithelium, which is estimated to be close to 100°C. For steady-state exposure to a laser beam the maximum temperature and time taken to attain equilibrium depends primarily on the retinal image size. For an image whose diameter is 20 μ, equilibrium is attained in ~10 msec. This time is too short to allow significant cooling from blood flow in the choroid. (BBB)

22630 INFLUENCE OF ROENTGEN AND ^{60}Co GAMMA RAYS ON DNA SYNTHESIS IN HAMSTER ORGANS. Lohmann, W.; Denny, W. F.; Perkins, W. H.; Moss, A. J. Jr.; Fowler, C. F. (Univ. of Arkansas, Little Rock). Acta Radiol. Therapy, Phys., Biol., 4: 3-6(Feb. 1966).

The incorporation of ^{14}C-thymidine into DNA in kidney, liver, and spleen of hamsters after whole-body x or ^{60}Co gamma irradiation with 800 R was investigated. The DNA activity was determined 24 hours after irradiation. Compared to the control values, the values for the irradiated animals were: liver 81% (70%), kidney 65% (59%), and spleen 20% (13%). The data are discussed in relation to radiation damage at the cellular level. (auth)

22631 EARLY DEVELOPMENT OF TRANSPLANTED ^{90}Sr-INDUCED OSTEOSARCOMA BUDS. Nilsson, Agnar (Research Inst. of National Defence, Sundbyberg, Sweden). Acta Radiol. Therapy, Phys., Biol., 4: 7-16(Feb. 1966).

The development of ^{90}Sr-induced intramedullary osteosarcoma foci of cell proliferation (buds) was studied after transplantation to mice. The buds were found to be autonomous and not dependent upon the continued presence of ^{90}Sr in their environment in order to maintain their potentially malignant properties and develop into osteosarcoma. (auth)

22632 COMPARED EFFECTS OF RADIOSTRONTIUM AND ROENTGEN RAYS ON GERM CELLS IN MALE MICE. Henricson, B.; Nilsson, A. (Research Inst. of National Defence, Sundbyberg, Sweden). Acta Radiol. Therapy, Phys., Biol., 4: 26-32(Feb. 1966).

The effect of ^{90}Sr (0.7 μC/g bodyweight) on different types of spermatogonia in mice was compared to total-body irradiation of 12, 25, 50, and 100 R rays, the strontium dose used apparently corresponding to 12 R or 12 to 25 R rays. When irradiated before the DNA-synthesis of A-spermatogonia stage VIII, the strontium effect was greatest. Results of a comparison with the effect of x radiation are discussed. (C.H.)

22633 CHROMOSOME ABERRATIONS AS A BIOLOGICAL DOSIMETER. Kelly, Sally; Brown, Charles D. (New York State Dept. of Health, Albany). Amer. J. Public Health, 54: 1419-29(Sept. 1965).

Changes in human chromosome following x irradiation of freshly drawn blood in vitro were photographed and enumerated from three-day-old cultures of leukocytes. Among the forms of radiation damage observed were abnormal numbers of chromosomes (aneuploidy, polyploidy, endoreduplication), fragmentation of chromosomes (chromatid- and chromosome-type deletions), and abnormal chromosomes forms (dicentrics, rings, and translocations). The frequency-dose relations were linear for aneuploidy and chromatid-type deletions but were curvilinear (quadratic) for polyploidy, chromosome-type deletions, and dicentric chromosomes. Possible applications of these results to the standardization of a biological dosimeter of radiation damage in man and their limitations were discussed. A table was compiled of previous data for in vivo exposure of human cells. (TCO)

22634 A STUDY OF INTERFERON: METHODS OF PRODUCING INTERFERON IN CHICKEN EGGS INCUBATED UNDER THE INFLUENCE OF LIVING AND INACTIVATED (UV) NEWCASTLE DISEASE VIRUS. German, A.; Panouse-Perrin, J.; Quero, A.-M. (Faculte de Pharmacie, Paris). Ann. Pharm. Franc., 23: 429-43(June 1965). (In French).

The concentration of interferon in chicken embryos was determined by the 50% inhibition of the plaques produced by the Sindbis virus. The Newcastle disease virus (myxovirus multiformis) induced the formation of interferon in proportion to the age of the embryo. The highest level of interferon in the nonirradiated group was found after 48 hr of incubation, when all the embryos were dead. After exposure to uv for ten sec, eight out of ten embryos survived 48 hr. After 20 sec exposure, nine out of ten survived 48 hr, three survived 72 hr, and one survived 96 hr. After 60 sec exposure to uv rays, seven out of ten embryos survived 48 hr, three survived 72 hr, and two survived 96 hr. Thus, the virus in embryos exposed to irradiation could only induce the production of interferon in proportion to the amount of surviving, intact virus. When the Newcastle disease virus was totally inactivated by uv radiation, no interferon was produced. (BBB)

22635 HYDATIDOSIS AND HEPATOSPLENIC THOROTRASTOSIS. Clay, A.; Dupont, A.; Demaille, A.; Adenis, L. (Faculte de Medecine, Lille). Arch. Anat. Pathol. Sem. Hop., 12: 45-7(Mar. 1964). (In French).

Hepatic and splenic lesions are reported in a patient who had previously undergone hepatography by means of Thorotrast for hydatid cysts. The splenic parenchyma contained large areas of dense sclerotic collagenous tissue that contained granular deposits. The location of the deposits, then density and morphology, and the sclerosis with which they associated indicated splenic thorotrastosis. Much of the spleen was occupied by large hydatid cysts. The hepatic parenchyma was extremely altered from normal, with densely sclerosed collagenous areas. Part of these had a brushlike arrangement and others an annular arrangement, and were discontinuously located within the liver. In some areas the sclerosed tissue was isolated and associated with granular deposits that presented the same appearance as those observed in the spleen. These deposits were usually restricted to the areas of sclerosis, but sometimes they were found distributed in the hepatic parenchyma. There was no evidence of vacuolization or nuclear alterations in the parenchymal cells. (TCO)

22636 SKELETAL DEFORMITIES FOLLOWING RADIUM AND ROENTGEN THERAPY RADIATION. Caruso, A. M.; Dimiccoli, N. (Univ., Florence). Arch. "Putti" Chir. Organi Movimento, 20: 78-92(1965). (In Italian)

Case histories, photographs, and radiographs are provided of six children who developed skeletal deformities after radiotherapy for cutaneous hemangiomas. The age of the patients ranged from 7 to 14 yr. Deformities in 3 cases involved the knee, the articular cartilage being in the radiation field. Radium or x-ray therapy was instituted in these cases in the first months of life (about the 3rd month on the average), but the dose and technical details of treatment are unknown. In one case, treatment of angiomas over the lower part of both femurs resulted in deformity of only one knee. The deformities were usually first noted about the fifth year of life, then became progressively worse. The skeletal anomalies were accompanied by hypertrophy of muscle and skin; however, the main hazard in irradiation of developing tissue is exposure of cartilage to high radiation doses. Subsequent growth of bone is then incomplete. Thus

radiotherapy of benign conditions over the epiphyseal region of young children should be avoided. (BBB)

22637 STUDIES ON THE MECHANISM OF THE SECOND SYNDROME FOLLOWING BONE MARROW TRANSPLANTATION. Kuroyanagi, Takeo; Saito, Masanobu (Tokyo Univ.). Arerugi, 13: 188-96(Apr. 1964). (In Japanese).

The secondary syndrome was studied in rats that were given 800 R whole-body irradiation prior to receiving transplants of rabbit bone marrow and spleen. Transplants from both normal and sensitized rabbits were investigated. It was concluded that the secondary syndrome is caused by the graft-vs-host reaction. The production of antibodies against host tissues by the transplanted donor cells was inhibited because of the presence of a large amount of antigen. Thus the secondary syndrome was more severe in rats receiving transplants of bone marrow from sensitized rabbits than in rats receiving such transplants from normal rabbits. (TCO)

22638 SKIN REPAIR IN ACUTE RADIATION NECROSIS. Afrikanova, L. A. Arkh. Patol., 24: 42-6(Jan. 1962). (In Russian).

Morphology of the healing process offer acute radiation-induced necrosis of the skin was studied. Experiments were conducted on 150 male albino rats weighing 150 to 180 g. A 4-cm^2 section of the dorsal skin was exposed to relatively weak x rays (a dose of 5250 R at a dose rate of 1500 R/min, generated at 30 kv). In one and a half to two weeks after irradiation a necrotic area had formed in all the rats, and in some rats full re-epithelization of the skin area had occurred in 40 to 60 days. The animals were observed for $1\frac{1}{2}$ years after irradiation. The development of a nidus of radiation-induced necrosis was characterized by its slow rate and the absence of any evidence of inflammation. Significant disturbances in regenerative processes were present during healing of radiation necrosis of the skin; layers of proliferating epidermis and new connective tissue began forming in the edges and bottom of the radiation-necrosis ulcer from the moment of its formation. The disturbances noted during the course of regenerative processes apparently did not affect the proliferative ability of the tissues, but were evident from altered differentiation of tissue structures. (BBB)

22639 SOME STUDIES ON LIVER INFILTRATES IN RADIATION CHIMERAS. Uyeki, E. M.; Palotay, J. L. (Battelle-Northwest, Richland, Wash.). Brit. J. Exp. Pathol., 46: 577-82(Dec. 1965). (BNWL-sa-132).

The early response of host liver tissue to the injection of syngeneic bone marrow, xenogeneic bone marrow or spleen cells, xenogeneic serum protein, lysed xenogeneic bone marrow, and polyvinylpyrrolidone (PVP) were studied. Observations were made of the distribution of cell types and microscopic foci of cellular infiltrates in host liver tissue during the first two weeks following treatment. Radiation chimeras were prepared by exposing male LAF mice to 950 R of x irradiation followed within 2 hr by an intravenous injection of 2×10^7 viable bone marrow or spleen cells from Sprague-Dawley rats, Fisher rats, or LAF mice. Assessment of focal cellular infiltrates in liver proved of value in detecting graft-host interaction in radiation chimeras in the first week after treatment. Results indicated that x irradiation in the dose range of 400 to 950 R before donor cell injection abolished the focal cellular infiltrates of liver tissues analyzed 3 days after treatment. However, this reduction may have been only a temporary impairment since an increase in focal infiltrates was observed 7 days after treatment in 950 R irradiated LAF mice given rat bone marrow. The possible mode of action by which x irradiation suppresses the formation of these infiltrates is discussed. One explanation is that x irradiation (in the range of 400 to 950 R) of the host greatly reduces the number of immunologically competent host cells participating in this graft-host interaction. (BBB)

22640 ON STEM-CELL RECOVERY AFTER IRRADIATION. Porteous, D. D.; Lajtha, L. G. (Christie Hospital, Manchester, Eng. Holt Radium Inst., Manchester, Eng.). Brit. J. Haematol., 12: 177-88(Mar. 1966).

Changes in the stem-cell population in mice during repeated x irradiation or at times after a single dose of whole-body irradiation were studied using techniques in the intact animal, or a technique in which bone marrow or spleen cells from irradiated experimental animals were grafted into heavily irradiated test mice. After a single dose of 150 rad, fortnightly doses of 150 rad, weekly 180 rad, and during repeated 50 rad daily, the technique involving grafting consistently showed different response patterns from those obtained using techniques in the intact animal. Only those measurements made immediately after a single dose of radiation were similar. The pattern of stem-cell recovery after 150 rad using three different techniques in intact animals (erythropoietin response, changes in $LD_{50/30}$, and auto-repopulation from shielded femur) showed that by 7 or 8 days normal values were reached, then followed a period during which it was suggested that the animals had at least twice normal stem-cell numbers. Return to normal values was seen at the end of the third week. The method involving marrow grafting did not give any indication of recovery before the 10th day and followed a different time course from that seen in the more physiological tests using the intact animal. These results are discussed briefly and it is concluded that grafting techniques do not measure stem-cell numbers in an unqualified fashion and that there is no good reason to postulate two kinds of stem cells. (auth)

22641 EXTREME HYPOXIA; ITS EFFECT ON THE SURVIVAL OF MAMMALIAN CELLS IRRADIATED AT HIGH AND LOW DOSE-RATES. Hall, Eric J.; Bedford, Joel S.; Oliver, Raymond (Churchill Hospital, Oxford). Brit. J. Radiol., 39: 302-7(Apr. 1966).

HeLa cells cultured in vitro were used to measure the oxygen enhancement ratio for acute (110 rads/minute) and protracted (32 rads/hour) exposures to γ radiation. Values of 2.4 and 1.5 respectively were found to apply. It was also discovered that if cells are stored for 24 hours under conditions of extreme hypoxia their sensitivity to acute doses is increased; the survival curve loses its initial shoulder and becomes a simple exponential function of dose. (auth)

22642 RADIOSENSITIVITY OF MURINE LEUKAEMIA CELLS IRRADIATED IN VIVO WITHIN INFILTRATED LYMPH NODES. Hewitt, Harold B. (Mount Vernon Hospital, Middlesex, Eng.). Brit. J. Radiol., 39: 308-12 (Apr. 1966).

A survival curve was determined for murine leukemia cells x irradiated in vivo within moderately infiltrated lymph nodes. This curve was indistinguishable from that previously determined for cells of several leukemia lines infiltrating the livers of leukemic mice and irradiated in vivo. These results indicate that the leukemia cells in lymph nodes are predominantly under well-oxygenated conditions. It is inferred that nodal lymphoid tissue cells respond as a well-oxygenated population when irradiated in the normal living animal. Limited clinical implications of the findings are discussed. (auth)

22643 RADIOPROTECTION OF THE RAT THYROID BY DIFFERENT ANTITHYROID COMPOUNDS. Greig, W. R.; McInnes, J. Brit. J. Radiol., 39: 313-16(Apr. 1966).

In experiments with 240 rats it was found that x irradiation in doses from 0 to 800 rads progressively impaired the capacity of the rat thyroid to increase in weight in response to goitrogenic growth stimuli. The effects of pre-treating the rats with saline and the antithyroid drugs methylthiouracil, aminotriazole, and sodium perchlorate, respectively, on the x-ray response data were measured. It was found that both methylthiouracil and aminotriazole were radioprotective while sodium perchlorate did not show this property. It is postulated that radioprotection of the thyroid by methylthiouracil may be of value in decreasing the rate of hypothyroidism which follows radio-iodine therapy for thyrotoxicosis. (auth)

22644 DETECTION OF EFFECTS OF IONIZING RADIATION BY POPULATION STUDIES. Hems, G.

(Radiological Protection Service, Sutton, Eng.). Brit. Med. J., 1: 393-6(Feb. 12, 1966).

A discussion is presented of problems that might arise in a population study undertaken to detect radiation effects. Estimates of a minimum population size (n) are given for the detection of mutations and leukemia attributable to the increased radiation. The estimates indicate that the minimum population sizes are far larger than those at present available, so that it is unlikely that they could be used to detect radiation effects. Estimates for the minimum number of fully exposed radiation workers necessary to permit detection of a mutation attributable to the increased radiation at a single locus, and radiation-induced leukemia, are compared with the occupational exposure of radiation workers in the U.K. It is emphasized that, in addition to the difficulty of fulfilling the requirement for a minimum population size, if a population study were undertaken to detect radiation effects, additional practical problems are likely to be encountered in setting up a satisfactory control population and in assessing mean annual doses. (TCO)

22645 INDUCED INTERCHANGE HETEROZYGOSITY IN DIPLOID CHRYSANTHEMUM. Rana, R. S. (Indian Agricultural Research Inst., New Delhi). Chromosoma, 16: 477-85(1965).

Survival of x-ray-induced chromosome interchanges and the nature spontaneous occurrence of thse events were studied in Chrysanthemum carinatum, a species having a high frequency of interchange heterozygosity. Interchanges were induced by an x-ray dose of 15 kR over dry seeds. An analysis of meiotic chromosome associations during microsporogenesis revealed that the X_1 population consisted of 113 structurally homozygous plants showing regular formation of 9 bivalents and 87 interchange heterozygotes forming multiple chromosome associations of various sizes indicating the presence of one to three interchanges. Plants carrying three interchanges were intercrossed among themselves and the F_1 seeds thus obtained were exposed to an x-ray dose of 10 kR. Cytologic observations on the following generation revealed plants carrying four or five interchanges and forming rings or chains of as many as 10 or even 12 chromosomes. Plants having four and five interchanges were intercrossed and the hybrid seeds were exposed to 10 kR of x rays. A study of meiotic chromosome associations in the subsequent generation showed that, although individuals heterozygous for one to five interchanges were frequent, none combined in it more than five interchanges. Further attempts to synthesize plants carrying more than five interchanges did not succeed. Thus, by recurrent irradiation and planned hybridization, it was possible in Chrysanthemum to form an interchange stock in which 12 of the 18 chromosomes are involved in rearrangements and form a single multiple association during meiosis. Factors governing the orientation of multiple association resulting from interchange heterozygosity are discussed. (TCO)

22646 STIMULATION OF THE AKR LEUKOGENESIS BY FRACTIONATED IRRADIATION. EFFECT OF ISOGENIC RESTORATION. Duplan, J. F. (Institut du Radium, Paris). Compt. Rend. Soc. Biol., 159: 1277-81 (Dec. 1965). (In French).

The fractionated irradiation at doses of 175 R in four consecutive generations of young AKR mice favors the development of lymphoid leukemia. The injection of isogenic hematopoietic cells immediately after the irradiation decreases slightly the stimulating effect of the x rays but does not inhibit as in the case of radioleukemogenesis. As this inhibition intervenes in the normal regulation mechanism of the lymphopoiesis, it was concluded that this regulating function is absent or deficient in AKR mice. One of the factors of spontaneous leukemogenesis would then be, in this line, a genetic incapacity to control the multiplication and/or the differentiation of lymphoid cells. (tr-auth)

22647 COMPARATIVE MORPHOLOGICAL AND RADIOBIOLOGICAL STUDY OF INTRATESTICULAR THYROID AUTO AND HOMOGRAFTS IN THE GUINEA PIG. Fabre, M.; Asch, L.; Marescaux, J. (Faculte de Medecine, Strasbourg). Compt. Rend. Soc. Biol., 159: 1392-6(Dec. 1965). (In French).

The functional activity of intratesticular thyroid homo- and autografts in the guinea pig was studied by morphological and radiobiological methods. Thyroid fragments were implanted in the testicles of recipients. In the autografts the thyroid fragment was removed and immediately transplanted into one of the testicles. Implants were from donors of the same sex and weight as that of the recipients. Two months after the implantations all the animals received a dose of 0.5 μC of ^{131}I. The animals were sacrificed later. The results showed that after thyroidectomy of the receiver animals the thyroid homografts underwent a weight increase and gave identical stimulation energies to those of the homografts. Nevertheless the thyroid autografts fixed more ^{131}I than the homografts. In the animals not submitted to thyroidectomies, no hypertrophy was observed in either the homo- or autografts. They have the same morphological aspect as the thyroids of the carriers. The difference of the fixation of ^{131}I by the auto- and homografts cannot be attributed to the nature of the implanted thyroid fragments but it is connected to the activity of the thyroids in situ of the carrier animals. (J.S.R.)

22648 MEDICAL USE OF RADIATION AND GENESIS OF CANCER. Schulte-Brinkmann, W. (Institut und Klinik fuer Medizinische Strahlenkunde, Duesseldorf, Ger.). Deut. Med. Wochschr., 90: 1965-9(Oct. 29, 1965). (In German).

Radioinduced tumorigenesis by irradiation of specific areas, such as the skin, head, neck, uterus, bone, and thorax is reviewed. Tumors induced in these areas include squamous cell carcinoma, spindle cell sarcomas, hemangioendotheliomas, uterine tumors, osteosarcomas, giant cell sarcomas, osteochondromas, and thyroid carcinomas. The induction and development of leukemia and cancer after whole-body or bone-marrow irradiation is discussed. Incorporation of radioisotopes as a source of tumor induction is also reviewed. It is concluded that the risk of tumor induction from radiation or radioisotopes is greater in young patients than in older patients. (TCO)

22649 CHROMOSOMES OF BONE MARROW CELLS REMOTELY AFFECTED BY IONIZING RADIATION. Barakina, N. F.; Yanushevskaya, M. I. (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 165: 427-30(Nov. 11, 1965). (In Russian).

Studies were made on the effects of ionizing radiation on the chromosomes of bone marrow cells on type C57BL mice of both sexes weighing 18–20 g. X-ray exposure conditions were: 210 kw, 15 ma, filter 0.75 mm Al, 0.5 mm Cu, dose rate 50 r/min. The animals were divided into three groups. In the first group, only one rear limb was exposed at a dose rate of 700 R; all other parts were shielded. In the second group, surgically exposed intestines were subjected to a dose rate of 700 R; the bodies of the animals were shielded. In the third group, the intestines were exposed at a dose rate of 3000 R; the shielding consisted of 5–8 mm plates. The animals were destroyed after 2 and 6 hours, and 1, 2, 3, and 5 days after exposure. The shielded thigh bones were fixed in Carnoys fluid. Small pieces of bone marrow were strained, pressed, and frozen. Mitosis damage was checked during the late anaphase and telophase. The damage (chiefly bridges) originated not only in the exposed sections but also in the shielded sections of the hemogenic system. They were produced by humoral influences (usually appearing two hours after exposure) coming from exposed tissues, proved by the presence of broken chromosomes in bone marrow cells, in the same quantity and time, as in the case of local exposure of the small intestines, or in the case of injected extracts from the bone marrow cells or intestines of exposed mice. (CFSTI)

22650 THE EFFECT OF IRRADIATION ON THE MOUTH AND JAWS AND THE ROLE OF ORAL SURGERY IN RELATION TO IT. Sharawie, Aly (Cairo Univ.). Egypt. Dent. J., 7: 8-13(Apr. 1961).

Aspects of oral radiotherapy reviewed include: effect of irradiation on the mouth and jaws; role of irradiation in oral surgery; the role of the dental surgeon as regards irradiation; complications that may arise from irradiation and how to avoid them, especially osteoradionecrosis; and dental management of irradiation cases before, during, and after treatment. (TCO)

22651 RADIOSENSITIVITY OF ESCHERICHIA COLI B BACTERIA CONTAINING DIFFERENT AMOUNTS OF NUCLEIC ACIDS AND PROTEINS. Vizdalova, Milena; Liska, B. (Inst. of Biophysics, Brno). Folia Microbiol. (Prague), 11: 21-8(1966).

Attempts were made to determine whether radiosensitivity changes (evaluated from the shape of survival curves) corresponded to changes in the nucleic acid and protein contents of bacteria. E. coli B cultured under aerobic and anaerobic conditions were x irradiated at different phases of growth of the culture. Changes in the nucleic acid and protein contents and in the number of nuclear equivalents per cell were determined. The extrapolated value of the dose-survival rate curves increased proportionately to the increase in the cell components, but it was not in direct agreement with the increase in any of the individual components. The slope of the survival curves changed simultaneously with the extrapolated values, showing that radiosensitivity changes were probably of a complex character and that they might be the function of at least two factors, manifested as a change in the number and size of the targets (evaluated in terms of the target theory). Unlike the aerobic culture, the irradiated culture grown under anaerobic conditions was most resistant in the stationary phase. Differences in the resistance of the anaerobic culture at the onset and end of the logarithmic phase were relatively small. It cannot, therefore, be said that radiosensitivity to the doses which more than 2% of the cells survived was proportionate to the nucleic acid and protein concentrations in the cell. (BBB)

22652 CUTANEOUS-MUCOSAL, OSSEOUS, AND DENTAL COMPLICATIONS OF RADIOTHERAPY AND CURIETHERAPY. Friez, P. (Hopital Saint-Louis, Paris). Gaz. Hop. Civils Mil., 133: 1237-42(Oct. 10, 1961). (In French).

The immediate reactions of the facial area to irradiation with α, β, or γ radiation, or to x rays are the appearance of erythema, epilation, exudative dermatitis, and exudative epithelitis. Late reactions may include depigmentation, chronic ulceration, poor scar formation, or skin tumors. The salivary glands may be irradiated, resulting in functional and histological changes. In more deeply situated tissues, such as the tongue or larynx, epitheliomas or sarcomas may be induced by irradiation. Delayed radionecroses may develop from 10 to 20 yr after irradiation, and may appear to be initiated by trauma, a local infection, or dental treatment. Odontoradionecroses may also develop. It is concluded that any treatment of the oral cavity in a previously irradiated person should be considered carefully before being undertaken. (TCO)

22653 NONDISJUNCTION OF THE X CHROMOSOMES IN FEMALES OF DROSOPHILA HYDEI. Gregg, Thomas G.; Day, John W. (Miami Univ., Oxford, Ohio). Genetica, 36: 172-82(1965-66).

An investigation of nondisjunction in Drosophila hydei has disclosed that spontaneous primary nondisjunction of the X chromosomes occurs with a frequency of 1/13000, and secondary nondisjunction with a frequency of 1/3500. These rates are much lower than the ones previously reported for Drosophila melanogaster which are about 1/1000 for primary nondisjunction and 1/50 for secondary nondisjunction. Data are included on a population derived from matings with females exposed to 2000 R or 4000 R x radiation. The low rate of secondary nondisjunction in hydei is attributed to the much greater genetic length of the X chromosome and the corresponding reduction in noncrossover X's available for distributive pairing with the Y chromosome. The low rate of primary nondisjunction is attributed to both a reduction in noncrossover X chromosomes, and to the large heterochromatic arm of the X chromosome which, it is suggested, makes the X centromere a strong centromere. Thus, it is further suggested, the reduction in noncrossover chromosomes reduces the opportunity for nonhomologous distributive pairing and nondisjunction of the type involving noncrossover chromosomes. Nondisjunction of the type involving crossover chromosomes then is prevented by the success of the strong centromeres in overcoming entanglements that would lead to nondisjunction in the case of ordinary or weak centromeres. (C.H.)

22654 RECOVERY OF γ- AND UV-RADIATION-INDUCED PREMUTATIONAL DAMAGE IN YEAST. Arman, I. P.; Kuznetsova, O. B. (Kurchatov Inst. of Atomic Energy, Moscow). Genetika, No. 1, 89-99(July 1965). (In Russian).

The recovery of premutational damage leading to gene mutations in Saccharomyces cerevisiae of different ploidy was studied. It was shown that in haploid, diploid and triploid strains of identical origin and homozygous for two biochemical markers the frequency of γ- and uv-radiation induced back mutations can be considerably reduced. The degree of recovery of premutational damage when cells are placed for 22 to 24 hours in a buffer (30°C) after irradiation increases with dose. Furthermore, the degree of recovery differs with ploidy depending upon the kind of radiation employed. It was found that the degree of recovery is independent of the rate of induced mutability. (auth)

22655 STUDIES ON THE NATURE OF X-RAY-INDUCED SOMATIC MOSAICISM IN HETEROZYGOTE YELLOW AND SINGED FEMALES OF DROSOPHILA MELANOGASTER. Tupitsyna, E. M. (Inst. of Biological Physics, Moscow). Genetika, No. 1, 123-9(July 1965). (In Russian).

The frequency of body spots (single and double) in heterozygote y and sn Drosophila melanogaster females was investigated. In the control all spots, both single and double, are probably the result of crossing-over in the region between gene sn and the centromere. Single spots are primarily the result of the incomplete development of the complementary spot. The relationship between the manifestation of the character as a double spot and the time of its appearance is the same as the relationship between the size of a cell population and the number of cell divisions (for a given period). It is concluded that both in the experiment and the control most of the spots, including single ones, arise as a result of crossing-over. (auth)

22656 MUTUAL ACTION OF DIFFERENT MUTAGENES ON BARLEY. Valeva, S. A. (Inst. of Biological Physics, Moscow). Genetika, No. 2, 106-12(Aug. 1965). (In Russian).

Mutation frequency and spectra were studied in barley seeds given various doses of γ radiation in combination with different concentrations of ethyleneimine. In other experiments hydrazine and hydroxylamine along or in combination with ethyleneamine or ethyleneimine were used following γ-irradiation to study chlorophyll mutations. Data showed that treatment with ethyleneimine following exposure to various doses of γ radiation enhanced mutagenesis, an effect that was increased by the further addition of hydroxylamine. (H.G.D.)

22657 SPECIFIC FEATURES OF MUTATIONAL CHANGES IN PEA VARIETIES AND FORMS. Sidorova, K. K.; Kalinina, N. P.; Uzhintseva, L. P. (Inst. of Cytology and Genetics, Academy of Sciences, Novosibirsk, USSR). Genetika, No. 2, 136-42(Aug. 1965). (In Russian).

The frequency and spectrum of mutations induced by ethyleneimine and γ-irradiation were studied in four varieties of peas. It was found that varieties and forms differing in morphological characters and origin are characterized by a specificity of induced mutational variation. The specific mutagenic effect of γ radiation and ethyleneimine was less marked than the specificity of mutational variation of the different pea varieties. The seed variety Thorsdag produced the greatest number and the broadest spectrum of mutations. Few mutations were found in the Abyssinian variety, a form closely related to wild pea species. Mutants of economic significance were produced

that may serve as valuable material for breeding work. (auth)

22658 PRODUCTION OF ECONOMICALLY VALUABLE ARTIFICIAL MUTATIONS IN GREEN CROP CULTURES. Shcheglova, N. S. (Research Inst. of Agriculture, Moscow). Genetika, No, 2, 143-7(Aug. 1965). (In Russian).

Application of γ rays, fast neutrons, colchicine or ethyleneimine to various species of spring wheat and spring barley revealed that different types of mutagens are species-specific in response. The highest percentage of mutations was produced by γ-rays at 10,000 and 15,000 R doses respectively and by ethyleneimine at a 0.03% concentration. The greatest number of practically valuable mutations were produced by γ-rays at a dose of 10,000 R. Economically valuable mutations of spring wheat and spring barley were produced. (H.G.D.)

22659 EARLY-MATURED AND PRODUCTIVE MUTANTS OF TOMATOES INDUCED BY IRRADIATION WITH GAMMA RAYS. Kulik, M. I. (Inst. of Cytology and Genetics, Academy of Sciences, Novosibirsk, USSR). Genetika, No. 2, 148-52(Aug. 1965). (In Russian).

The economic value of tomato mutants produced by γ-irradiation was studied. Early varieties produced 25% more ripe fruit than the controls. Other mutations resulted in increased content of sugar and dry matter and enhanced taste. A group of dwarf-mutants were developed that produce normal-sized progeny and thus help to increase the harvest yield per unit area. (H.G.D.)

22660 RELATION BETWEEN DNA SYNTHESIS AND TYPES OF CHROMOSOME ABERRATION DURING GERMINATION OF PEA SEEDS IRRADIATED WITH X RAYS. Bogdanov, Yu. F. (Inst. of Radiation and Physico-Chemical Biology, Moscow). Genetika, No. 3, 35-43 (Sept. 1965). (In Russian).

Dry pea seeds of dwarf sort Pioneer were irradiated with 1500 R and 6000 R of x-rays, then moistened and kept for germination in thymidine-^{3}H for 36 hours in accordance with the method published earlier. Root tips were fixed with 3 to 4 hr intervals during the entire first mitotic cycle in starting roots and autoradiographs were prepared. After irradiation with 1500 R a routine (for mitotic cycle) dynamics of chromosome and chromatid bridges at anaphases was observed. G_2 chromosome bridges came first followed by chromatid bridges from S-cells and finally chromosome bridges appeared at the end of the first mitotic cycle. There was no considerable delay of mitosis after 1500 R as compared to control. After 6000 R approximately an 8 hr delay of mitosis was observed and inverted dynamics of chromosome bridges appeared firstly. The high level of chromosome bridges was maintained up to the end of the first mitotic cycle. G_2-chromatid bridges appeared only at the end of the first mitotic cycle. Chromatid bridges make 86.7% of the entire number of bridges following irradiation with 1500 R and only 55% are produced after 6000 R. It was concluded that the cell population of embryonic root meristem in resting seeds is asynchronous. It may happen that the degree of asynchronism in resting seeds is close to that in adult roots. (H.G.D.)

22661 RADIOMUTAGENESIS OF MAIZE. Lysikov, V. N. (Frunze Kishiney Agricultural Inst.). Genetika, No. 3, 44-8(Sept. 1965). (In Russian).

It is shown that with the aid of ionizing irradiation (γ-rays and neutrons) of pollen or a developed panicle, it is possible to produce a great number of new forms and markedly increase the valuable properties of the initial material required for practical needs of maize breeding. Special attention is paid to dwarf radiomutants and the progeny of the Corngrass mutation type. (auth)

22662 CYTOGENETIC ANALYSIS OF LETHAL MUTATIONS INDUCED AT VARIOUS STAGES OF SPERMATOGENESIS. Hashim-Ahmed, M. S. (Leningrad State Univ.). Genetika, No. 3, 49-55(Sept. 1965). (In Russian).

Premeiotic stages of spermatogenesis in x-irradiated (2000 R) Drosophila melanogaster showed a higher percentage of mutation when treated males were transferred to high temperature (36.5°C) for 8 hours as compared to 25°C. This phenomenon does not hold equally for a higher dose of 4000 R. Results indicate that the effect of high temperature on x-ray induced rate of point mutation in these stages may involve an enhancement of the mechanism of restitution which gives rise to interstitial microaberrations and lethals. High temperature led to an insignificantly higher rate of sex-inked lethals in 9 repetitions out of 10 in postmeiotic stages (sperms and spermatids). Between post-and-premeiotic stages there is a period of complete sterility, the duration of which exceeded 2 days for 2000 R, ran beyond 5 days for 4000 R and was not observed during spermatogenetic stages of males irradiated with 550 and 700 R. (auth)

22663 PRODUCTION OF INDEPENDENT SOMATIC MUTATIONS IN HAPLOID TOMATOES AND TRANSITION OF THE LATTER INTO A DIPLOID STATE. Kirillova, G. A. (Leningrad State Univ.). Genetika, No. 3, 65-9 (Sept. 1965). (In Russian).

An attempt was made to develop a method for the production of homozygous diploid forms by making use of induced somatic haploid mutants. Experiments were carried out in a haploid tomato plant. The irradiation with x-ray produced in the haploid tomato somatic haploid mutations along with their morphological characters. With the aid of colchicine the mutants were transformed into diploids. As a result of our study one haploid tomato plant produced 6 diploid forms of mutants. (auth)

22664 PRODUCTION OF QUICKLY RIPENING LARGE-SIZE BOLLS IN COTTON PLANTS UNDER THE INFLUENCE OF RADIOPHOSPHORUS. Nazirov, N. N.; Zhalilov, O. (Inst. of Experimental Plant Biology, Tashkent). Genetika, No. 3, 75-7(Sept. 1965). (In Russian).

Seeds of a quickly ripening cotton plant (variety 1306-DB) were soaked in a radiophosphorus solution prior to sowing. By using annual selection, a variety with increased boll yield and much higher fiber quality was produced. (H.G.D.)

22665 EXPERIMENTAL PRODUCTION OF MUTATIONS IN BUCKWHEAT. Zheleznov, A. V. (Inst. of Biology, Academy of Sciences, Novosibirsk, USSR). Genetika, No. 3, 78-84(Sept. 1965). (In Russian).

Gamma irradiation of buckwheat seeds resulted in an increase in natural variability and produced a number of mutants; some of which proved to be of practical value and may be of sufficient use as an initial material for buckwheat breeding. The highest rate of mutations was observed in 10,000 R series. Having exceeded this top level of irradiation doses, reduction of mutations was observed; this reduction is probably due to the fact that in injured cytoplasm survive only those nuclei which carry no mutations. The newly arising mutations in buckwheat may be fixed by means of sister crossings between two identical mutant forms. (auth)

22666 INTERRELATION BETWEEN THE LETHAL AND THE MUTAGENIC ACTION OF ULTRAVIOLET IRRADIATION ON THE EXTRACELLULAR C_d BACTERIOPHAGE. Zavil'gel'skii, G. B.; Kriviskii, A. S. (Inst. of Radiational and Physico-Chemical Biology, Moscow). Genetika, No. 4, 12-19(Oct. 1965). (In Russian).

The initial relationship between the lethal and mutagenic effect of uv irradiation (λ = 254 mmc) was studied in an extracellular bacteriophage C_d of E. coli. It has been shown that high doses of uv cause a reduction of mutation rate in bacteriophage C_d. Simultaneously a decrease of inclination of the phage survival curve has been observed. Under conditions of high doses a secondary raise of mutation rate is observed in the mutation curve and it is worthy to note that an inclination of the second raise is much less than the first one. It has been shown that in the course of the entire length of the survival curve of the C_d phage in DNA (apart from lethal and mutation injuries) the gradual effect of uv-irradiation results in the accumulation of non-lethal non-hereditary injuries which cause only a lagging in the reproduction of the irradiated phage. The authors suggest a hypothesis interpreting the observed effects from the posi-

tion of gradual reduction of size of the radiosensitive target in C_d phage directly under the ray. (auth)

22667 COMPARATIVE MUTAGENIC ACTIVITY OF SOME AROMATIC COMPOUNDS WITH OR WITHOUT γ IRRADIATION. Mosse, I. B.; Freimanis, Ya. F. (Inst. of Genetics and Cytology, Minsk. Inst. of Organic Chemistry, Riga). Genetika, No. 4, 69-73(Oct. 1965). (In Russian).

The effects of 9 aromatic compounds were tested in Drosophila for spontaneous and radioinduced mutations. Four preparations V-93, AV-69, F-4 and F-23 proved to be able to reduce the rate of recessive lethal mutations coupled with the sex induced by γ-exposure to 1500 R. Two of them AV-69 and F-23 also proved to be mutagens: AV-69 at the same concentration, F-23 at a greater concentration. The inefficiency of the F-25 and F-6 preparations may be ascribed to their insolubility in the nutrient media. Thus, a new class of genetically active compounds has been established. (auth)

22668 COMPARATIVE RADIOSENSITIVITY IN THE NUCLEAR APPARATUS OF MAMMALIAN CELLS IN VIVO AND IN VITRO. Osetrova, T. D.; Kerkis, Yu. Ya.; Lebedeva, L. I.; Morozova, L. M. (Inst. of Cytology and Genetics, Academy of Sciences, Novosibirsk, USSR). Genetika, No. 4, 74-9(Oct. 1965). (In Russian).

The radiosensitivity of chromosomes were compared in embryonic fibroblasts of a golden hamster, guinea pigs, and man in vitro and in the embryonic fibroblasts of a golden hamster in vivo throughout the entire generation cycle following x-irradiation 50 R. It was established that radiosensitivity of chromosomes in man and guinea pig throughout all the stages of the cell cycle is higher than the sensitivity of cell chromosomes in the golden hamster. It was further shown that the sensitivity of chromosomes in the cells of the golden hamster in vitro is greater than that of the same tissues in vivo. (auth)

22669 HETEROZYGOUS EFFECT OF MUTATIONS INDUCED IN THE SECOND CHROMOSOME OF DROSOPHILA MELANOGASTER. Shilenko, B. V. (Inst. of Biological Physics, Moscow). Genetika, No. 4, 109-14 (Oct. 1965). (In Russian).

The effects of irradiation of the second chromosome of an isogenous line of Drosophila were determined in accordance with the relative viability of individuals of the wild genotype in the F_2 cultures. There is evidence of the independence of viability from the competition. Irradiation of the chromosome did not affect the rate of heterozygotes development. (TCO)

22670 MUTAGENIC EFFECT OF GAMMA RAYS AND FAST NEUTRONS ON VICIA FABA CHROMOSOMES. Dishler, V. Ya. (Inst. of Biological Physics, Moscow). Genetika, No. 4, 124-30(Oct. 1965). (In Russian).

Vicia faba minor seeds were exposed to γ rays and fast neutrons. The number of cells revealing chromosome rearrangements during the entire cycle of meristem cells was examined in rootlets fixed at intervals of 4 hours. The relative biological effect of fast neutrons considerably increased with time ranging from seed germination to rootlet fixation, and comprised a value (in regard to the entire cell cycle) amounting to approximately 25. Gamma radiation delayed the onset of mitosis. Subsequent storage reduced the number of cells containing damaged chromosome recovery processes were inhibited by 2.4 dinitrophenol. (H.G.D.)

22671 EFFECT OF 8-ETHOXYCAFFEINE ON CHROMOSOMES IN CREPIS CAPILLARIS. Shevchenko, V. V. (Inst. of Biological Physics, Moscow). Genetika, No. 4, 138-49(Oct. 1965). (In Russian).

The effects of 8-ethoxycaffeine (EOC) on Crepis capillaris seedlings revealed that the mutagen, as well as x radiation, causes chromosome breaks during entire course of interphase. Cells of the G_2 phase showed maximal sensitivity. Although in Crepis capillaris the specific action of EOC at definite chromosome sites was not apparent, its effect proved to be characteristic and was distinguished in accordance with the distributional spacing of breakage frequency in separate chromosomes as a result of x-irradiation. Frequency of breakages was almost doubled in the C-chromosome, but was much less in the long arm of A-chromosome. In the course of EOC action separate cells were damaged severly, and the appearance of a considerable number of 4 N cells with chromosomes torn apart into a great number of fragments were observed. (H.G.D.)

22672 VARIABILITY OF GLUTEN CONTENT AND ITS QUALITY IN SPRING WHEAT. Chernyi, I. V. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Genetika, No. 4, 150-5(Oct. 1965). (In Russian).

The effects of ionizing radiation on hereditary variation of the contents and quality of gluten in F_2 spring wheat plants were studied. In testing the gluten quality of radioinduced morphological mutants a number of forms with improved gluten quality were selected. An analysis of F_2 plants of the Cesium III variety subjected to γ irradiation and fast neutrons have shown that these agents increase the variability of both the content and quality of gluten. Investigation of hereditability of gluten properties has shown that this character is sufficiently well preserved in subsequent generations. The value of utilizing mutagenic factors for the production of wheat forms with improved baking properties is considered. (auth)

22673 USE OF γ RAYS IN PEA BREEDING. Tereshchenko, N. M. (All Union Inst. of Forage, Moscow). Genetika, No. 4, 175-6(Oct. 1965). (In Russian).

Exposure of dry pea seeds to γ rays produced a variety of morphological and phenological mutations in the first generation. However, the new characters often did not appear in the progeny. Similarly, second generation mutations were not usually inherited by the third generation. Economic significance of γ-induced mutations in peas is discussed. (H.G.D.)

22674 MUTATION PROCESS OF CHLORELLA INDUCED BY INCORPORATION OF RADIOACTIVE CARBON DIOXIDE. Pluchennik, Henrik (Leningrad State Univ.). Genetika, No. 5, 19-25(Nov. 1965). (In Russian).

The mutagenic effects of ^{14}C and x-irradiation were studied in pigments of Chlorella vulgaris. Carbon-14 was 2 to 4 times more effective as a mutagen than x rays. Dose dependence variations in mutagenesis attested to the role of ^{14}C transmutation to ^{14}N within DNA. (H.G.D.)

22675 GENETICS OF A HETEROZYGOUS POPULATION OF DROSOPHILA MELANOGASTER. I. VIABILITY AND POPULATION FITNESS OF HETEROZYGOUS CyLcn/cnl10 CARRIER OF IRRADIATED CHROMOSOME cnl10. Shilenko, B. V. (Inst. of Biological Physics, Moscow). Genetika, No. 6, 104-9(Dec. 1965). (In Russian).

A new method of determining the heterozygous effect of radiation induced mutations is described. Normal second chromosome of a male belonging to a balanced lethal population CyLcn/+^{cn}l10 was marked with gene cn and then subjected to irradiation. Heterozygous individuals possessing normal chromosomes (marked cn l10) have been paired with individuals bearing non marked chromosomes (+^{cn}l10). Two crosses were carried out. The first cross CyLcn/cnl10 × CyLcn/+^{cn}l10 (chromosomes cnl10 being irradiated) represents the basis of the experimental population, while the second cross CyLcn/cnl10 × CyLcn/+^{cn}l10 (chromosomes cn10 being nonirradiated) represent the basis of the control population. It was shown that the proportion of the irradiated chromosome of the experimental population is the same as that of the nonirradiated chromosome of the control population. Viability variation of the irradiated chromosome in F_1 individuals CyLcn/cnl10 slightly exceeds that of nonirradiated cultures. The decreased rate of the proportion CyLcn/cnl10 in generations of both the experimental and the control population is the same. Proportion of marked genotypes in crowded cultures exceeds that of uncrowded ones. (auth)

22676 MUTATIONS IN THE PEA CAUSED BY X AND GAMMA IRRADIATION. Khangil'din, V. V. (Bashkirian Research Inst. of Agriculture, USSR). Genetika, No. 6, 120-6(Dec. 1965). (In Russian).

Radiosensitivity of several varieties of pea seeds x-irradiated with 10 kR doses was shown to be dependent on the size of the seeds. Mutation frequency and spectra were also found to be dependent on variety. (H.G.D.)

22677 RADIATION ENTERITIS WITH MALABSORPTION. Tankel, H. I.; Clark, D. H.; Lee, F. D. (Southern General Hospital, Glasgow). Gut, 6: 560-9(Dec. 1965).

The clinical, biochemical, radiological, and histological features are described for three cases of radiation damage to the small bowel that led to varying degrees of malabsorption. Treatment of the condition is discussed. Recommendations are made to confine the term radiation enteritis to the succession of changes associated with widespread microscopic changes in the small bowel and to refer to localized strictures, perforations, and fistulation as post-irradiation stricture, perforation, or fistula. (TCO)

22678 PATTERNS OF LEUKEMIA IN ISRAEL. Kallner, Gertrude. Hebrew Med. J., 1: 241-5(1965).

Some etiologic factors, including exposure to ionizing radiation, are considered in a discussion of leukemia epidemiology in Israel. Israel is among the countries with a high incidence of leukemia. A higher incidence of leukemia was found among children who had received x-ray epilation treatment for ringworm. No significant differences in leukemia rates were observed between Orientals and Occidentals. (H.G.D.)

22679 THE SIZE OF THE MUTATED SECTOR IN BARLEY SPIKES ESTIMATED BY MEANS OF WAXY MUTANTS. Eriksson, Goesta (Univ. of Stockholm). Hereditas, 53: 307-26(1965).

Resting barley seeds were treated with four doses of γ rays (5,000 to 16,000 rad) and four concentrations of a chemical mutagen (EMS) during 24 hours (0.12 to 0.50%). The size of the mutated sector in the X_1 spikes was estimated by the aid of mutation to the waxy phenotype of the pollen grains. Two of the treatments (8,000 rad γ and 0.25% EMS) and the control were analyzed for waxy mutants. An extremely high fraction of the spikes was found to carry mutations after the two treatments amounting to 40% using EMS and 20% using γ irradiation. The γ ray treatment gave rise to small sectors, comprising only four spikelets, as well as large ones comprising the entire spike. The EMS treatment, in most cases, showed small sectors not exceeding one side of the spike. In the EMS material there were more spikes with an irregular distribution of mutants than in the case of γ ray treatment. The induced frequencies of chloroplast mutants in the studied series were about equal to those reported by other investigators. (auth)

22680 PARASEXUAL CYCLE AND LINKAGE GROUPS IN PENICILLIUM EXPANSUM. Fjeld, Asbjoern; Stroemnaes, Oeistein (Univ. of Oslo, Blindern). Hereditas, 54: 389-403(1966).

The parasexual cycle in Penicillium expansum was verified. Two linkage groups were demonstrated and additional markers tested. A total of 23 haploid mutant strains induced by exposure to uv radiation was employed in the formation of 24 heterocaryons. From these, 20 heterozygous diploid strains were recovered, but three of them were stable and yielded to segregants. From the other 17, haploid and diploid mitotic segregants could be selected, and were obtained in greatly varying numbers. By making the assumption that one of the strains carried a translocation, the data satisfied the tentative hypothesis of at least four linkage groups. (auth)

22681 FETAL DISORDERS DUE TO IONIZING RADIATION. Tabuchi, Akira (Hiroshima Univ. School of Medicine, Japan). Hiroshima J. Med. Sci., 13: 125-73 (June 1964).

Data are presented from three investigations of the action of radiation on the fetus. The effects of large doses of radiation were evaluated by experiments in mice and by an investigation of children born of mothers exposed to the atomic bombing of Hiroshima. The effects of small doses of radiation were evaluated by a study of children born of mothers receiving obstetric care at public hospitals after having undergone diagnostic x-ray procedures. (TCO)

22682 OSTEORADIONECROSIS OF THE MANDIBLE. Kobayashi, Ichiro (Second Tokyo National Hospital). Iryo, 19: 93-101(Feb. 1965). (In Japanese).

The most frequent sequela of radiotherapy for oral cancer is osteoradionecrosis, resulting in a relatively high mortality. Sequestration in the mandible occurred after irradiation for oral cancer in 10 of 20 cases. Five cases showed aseptic necrosis, four of which were introduced by post-irradiation surgery. Thus, 100% oral impairment was observed. In 10 cases, there was no difference in these side-effects between telecobalt and other radiation treatments and no relation to dose. Any teeth in the irradiation area should be extracted; during irradiation, radiation stomatitis is an indication for discontinuation of radiation therapy. After irradiation therapy, surgical procedures should be used when needed and close follow-up studies made. (BBB)

22683 VARIETY DIFFERENCES OF SENSITIVITY TO X RAYS IN THE PEANUT. Bilquez, A. F.; Martin, Jean-Pierre (Institut d'Enseignement et de Recherches Tropiques, Bondy, France). J. Agr. Trop. Bot. Appl., 8: 30-43 (Jan.-Feb.-Mar. 1961). (In French).

Radiosensitivity of two peanut varieties was examined to determine the optimal x-ray doses for mutation breeding studies. A rapid-growing type and a slow-growing variety were exposed as dormant seeds at 5% relative humidity to 140-kv x rays at 80 R/min. After doses of 8,000, 12,000, 16,000, 20,000, 24,000, 28,000, 32,000, 36,000, and 40,000 R the seeds were planted in the field. The rapid-growing variety showed a radiosensitivity clearly lower than that of the slow-growing variety, the average ratio being 1 : 1.7. Similar results were found with respect to fertility and loss of vigor of the plants. Variations in radiosensitivity between the two varieties may be attributed to differences in degree of seed hydration. (TCO)

22684 RADIATION EFFECTS ON MOUSE SUBMANDIBULAR GLAND. Santangelo, Mario V.; Toto, Patrick D. (Loyola Univ., Chicago). J. Dent. Res., 44: 1291-8 (Nov.-Dec. 1965).

The effects of low-dose, chronic γ irradiation on the submandibular gland of the mouse were studied to determine if these effects would manifest themselves as an alteration in the morphology of the salivary gland or as a disturbance in the secretory function of the gland. Male, 100-day-old mice were used for histological studies of the submandibular gland. Animals were irradiated for a total of 100 days with 12 R of γ radiation daily for a total cumulative dose of 1200 R or for 200 days with the same dose for a total cumulative dose of 2400 R. No histopathologic or histochemical changes were observed in the submandibular glands following 12 R of daily γ radiation for a period of 100 days, but moderate-to-severe alterations were seen after 200 days of irradiation at the rate of 12 R/day. The mouse submandibular gland showed functional changes, namely, a reduction in number and chemistry of the secretory granules. The structural alterations were characterized as degenerative and necrotic changes of both the intralobular-duct cells and the acini. The supporting argyrophilic fibers of the gland were decreased in number as a result of 200-day irradiation. However, this decrease in periductal fibrous tissue was slight and a rather insignificant finding when compared to the severe changes in the parenchyma. (TCO)

22685 THE EFFECT OF HYDROCORTISONE AND X-IRRADIATION ON THE LYMPHOCYTOSIS INDUCED BY BORDETELLA PERTUSSIS. Morse, Stephen I. (Rockefeller Univ., New York). J. Exp. Med., 123: 283-98 (Feb. 1, 1966).

In mice rendered lymphocytopenic by x irradiation or hydrocortisone acetate, pertussis vaccine evoked both lymphocytosis and polymorphonuclear leukocytosis. A non-lethal dose of 650 R given to NCS mice produced a profound leukopenia for more than 2 weeks. The effect of pertussis vaccine on irradiation-induced leukopenia was studied in mice which had received 650 R 5 days previously, then injected with 0.3 ml of pertussis vaccine intravenously. Within 24 hr after the administration of vaccine, the average leukocyte counts of previously irradiated animals rose from 1200 to 8250 cells/mm^3, a 7-

fold increase. Four days after the injection the counts had risen more than 13-fold and total leukocyte counts were within normal limits. Although there was a marked increase in the numbers of circulating lymphocytes, the predominating cell type was the polymorphonuclear leukocyte. Although neither this dose of irradiation nor pertussis vaccine alone produced lethal effects, significant mortality was observed when both agents were employed. Administration of adrenal cortical hormones did not cause an accelerated loss of lymphocytes from the blood of pertussis-treated animals. These observations suggest that adrenal cortical hormones are not lymphocytolytic with respect to circulating lymphocytes. Although pertussis vaccine cannot be utilized as a therapeutic measure for radioinduced leukopenia, it might be a useful tool to evaluate the residual extracirculatory pool of cells that can be mobilized after various doses of x rays. (BBB)

22686 RADIATION-INDUCED MORPHOLOGICAL MUTANT OF JUTE. **Basu, Rabindra Krishna (Bose Inst., Calcutta). J. Genet., 59: 60-9(Nov. 1965).**

Cytogenetic studies of a dwarf, semi-sterile, small-fruited mutation in Corchorus capsularis that was induced by x radiation are reported. The plant under investigation was the only one of its kind in the X_3 generation and was characterized by being short, slender, and bearing thin, narrow, lanceolate leaves that were much smaller than those of the control plants. The differences in plant height, basal diameter, and leaf dimensions at maturity in the mutant with respect to those of the control are shown. Out of 5 sepals and 5 petals, only 2 to 3 opened in each whorl. There was considerable reduction in the number of flowers per plant. Capsules of varying sizes and low seed yield were also characteristic of the mutant. Meiosis from diakinesis onwards was studied in both the mutant and the control plants. The mutant showed irregular meiosis and most of the chromosomal abnormalities were observed from diakinesis to anaphase II of microsporogenesis. Diploid chromosome was the same in controls and mutants. In the mutant, pairing appeared to be disturbed as univalents were often seen at prophase, metaphase, and anaphase stages of the first division. Metaphase plates with seven bivalents showing considerable size differences were also observed, and separation of bivalents during anaphase I was often unequal. Nondisjunction of bivalents was frequent and varying number of univalents, bivalents, and fragments were observed to lag behind. Pollen grain sterility, as judged by shape, size, and contents, was found to be about 58% in the mutant, compared with only 2 to 3% in the control. The F_1 plants raised by using control plants as the female parent were fully fertile and meiosis in them was regular. (TCO)

22687 RECENT SOVIET WORK ON REACTIONS OF THE CENTRAL NERVOUS SYSTEM TO IONIZING RADIATION. **Stahl, Walter R. (Oregon State Coll., Corvallis). J. Nerv. Ment. Dis., 131: 213-33(Sept. 1960).**

Soviet research on radiation effects in the central nervous system published between 1958 and 1960 is reviewed. There appears to be no unanimity in the Soviet literature on the threshold of CNS radiosensitivity. Some observers claim important conditioned-reflex alterations at doses of a few R, while others are able to produce essentially normal reflexes after cumulative doses of many thousands of R. Some researchers find an electroencephalographic effect at very low doses, indicating increased afferent inflow to CNS, while others observe transient responses or no effect after many hundreds of R. It is pointed out that careful distinction must be made between various types of CNS reactions to radiation, such as retinal stimulation, which is without pathological significance, and outright damage to the CNS. Because of the very complex nature of many of the experiments reviewed no conclusion on the radiosensitivity of the CNS seems possible at this time. It is concluded that the Pavlovian techniques used by Russian investigators provide an important means for certain dynamic studies of physiological processes sensitive to radiation. However, some of the most important radiation reactions, such as bone marrow depression, cancer production, and genetic mutations, are under direct nervous control, and are therefore difficult to study by the Pavlovian method. (TCO)

22688 INCORPORATION OF TRITIATED THYMIDINE INTO MOUSE BRAIN AFTER A SINGLE DOSE OF X-RAYS: AN AUTORADIOGRAPHIC STUDY. **Hassler, Ova (Univ. of Umea, Sweden). J. Neuropathol. Exp. Neurol., 25: 97-106(Jan. 1966).**

Adult mice were irradiated with a single 2370- or 4740-rad dose of x-rays on one cerebral hemisphere while the rest of the body was shielded by lead. Thymidine-^{3}H was injected between 1 hr and 9 months after irradiation, most animals were killed 2 hr, and sections of the brain were examined by autoradiography. A markedly decreased number of labeled subependymal cells was observed in the irradiated hemisphere as compared to the opposite control hemisphere; the decrease was almost as great after 1 day as it was 9 months after irradiation. The number of glial cells with dark nuclei (probably precursors to oligodendrocytes and possibly also to astrocytes) was decreased 1 to 24 hr after irradiation, increased 4 to 7 days after irradiation, and not significantly changed 1 to 9 months after irradiation. The labeled microglia and vascular endothelium nuclei constituted a small proportion of the labeled nuclei, and no significant change in their occurrence was encountered. When the higher dose of radiation (4740 rad) was administered, more marked changes of a similar type were observed in the content of labeled cells. (TCO)

22689 PERSISTENCE OF IMMUNITY FOLLOWING DOUBLE VACCINATION OF PUPS WITH X-IRRADIATED ANCYLOSTOMA CANINUM LARVAE. **Miller, T. A. (Univ. Coll., Nairobi, Kenya). J. Parasitol., 51: 705-11 (Oct. 1965).**

Dogs of various ages can be immunized against a challenge of normal Ancylostoma caninum larvae by the administration of two doses, preferably by subcutaneous injection, of 40 kR-irradiated larvae. Experiments were designed to investigate the persistence of dog immunity to Ancylostoma caninum over various periods of time after vaccination and to examine the immunity of such pups when exposed during the interval between vaccination and challenge to a low-level continuous infection with normal larvae. Vaccination with x-irradiated larvae stimulated an apparently maximum immunity which was not further improved by numerous small infections of normal larvae to the vaccinated dogs and bitches during the period between vaccination and the challenge at 11 months of age. (TCO)

22690 EFFECTS OF X-RAYS AND RADIOMIMETIC SUBSTANCES ON KURLOFF BODIES. **Barer, R.; Joseph, S. (Univ. of Sheffield, Eng.). J. Physiol. (London), 182: 1P-2P(Jan. 1966).**

Since lymphocytes are extremely sensitive to x rays and some radiomimetic drugs, these agents were used to investigate the nature of Kurloff cells in guinea pigs. A chronic depletion of lymphocytes was produced by a series of injections of methyl methanesulfonate (MMS). The experiments show that MMS destroys lymphocytes but has little or no effect on cells containing Kurloff bodies already present in the tissues and blood, also that MMS does not inhibit the production of Kurloff bodies by estrogens even when the lymphocytes have been greatly depleted. Similar experiments were carried out with other radiomimetic drugs and with x rays. The results suggest that the Kurloff cells are not radiosensitive and are probably not true lymphocytes. Electron microscopy indicates that they are of a more primitive nature and may be reticular cells. (TCO)

22691 RESISTANCE OF TOXOPLASMA GONDII TO ULTRAVIOLET IRRADIATION. **Rifaat, M. A.; Morsy, T. A.; Sadek, M. S. M. (Ain-Shams Univ., Cairo). J. Trop. Med. Hyg., 69: 1-2(Jan. 1966).**

The influence of the irradiation of a uv lamp on the viability and virulence of the RH strain of Toxoplasma, in normal saline, pasteurized milk, human urine, and a broth dilution of infected mouse peritoneal fluid, was studied. Results were assessed by subsequent intraperitoneal inoculation of the parasite into susceptible mice.

The inocula consisted of peritoneal exudate obtained on the third day from mice infected intraperitoneally with Toxoplasma diluted with the suspending fluid in a ratio 1:5. The inocula were spread in sterile petri dishes forming a layer not more than 2 mm thick, and were exposed to a uv sterilization lamp (Philips) at a wavelength of 3000 to 5000 Å. Parasites in peritoneal exudate diluted in saline remained infective up to 40 min, in human urine (pH 7) up to 2.5 hr, in broth up to 4 hr, and in pasteurized milk up to 5 hr. In all cases the parasite appeared in the peritoneal exudate of inoculated mice within eight days, and the mice died within 10 to 20 days. The parasite retains its infectivity for a longer period in saline than in milk at room temperature. On the other hand, on exposure to uv in these media, the infectivity of the parasite was retained for a longer period in milk than in saline. The same was noticed as regards the parasite suspended in broth and urine. The possibility of the medium (milk, broth, or urine) reducing the susceptibility of the organism to the irradiation seems illogical. The probability is that the dose of irradiation reaching the parasite is diminished to some extent through passing in such an opaque medium as milk, or the protein contained in milk, broth, or albumin absorbs some of the rays. (BBB)

22692 EXPERIMENTAL STUDIES ON THE EFFECTS OF INTERNAL EXPOSURE OF ^{137}Cs ON THE MALE REPRODUCTIVE ORGAN. REPORT I. THE EFFECTS ON COPULATION, PREGNANCY, AND LITTER SIZE BY MATING MALE MICE INTERNALLY EXPOSED TO ^{137}Cs WITH NORMAL FEMALES. Tamura, Toshiyuki (Okayama Univ., Jap.). Jap. J. Hygiene, 20: 268-76(Oct. 1965). (In Japanese).

The reproductive ability of male mice receiving internal exposure to ^{137}Cs was observed. ^{137}Cs was administered intraperitoneally to dd-strain male mice at the rate of 8 μC per gram of body weight to a first group and 4 μC per gram to a second group. The males were mated with non-treated females every ten days up to 100 days. From twelve to fourteen days after copulation, the mated females were killed, their uteri opened, and pregnancy and litter size examined. The copulation rate decreased from 20 to 70 days after ^{137}Cs administration, expecially between 60 and 70 days in the first group. The pregnancy rate decreased in almost the same way. In the first group, it fell steadily from 10 days, finally reached zero between 60 and 70 days, and then recovered gradually. The litter size showed a pattern similar to the pregnancy rate. The number of dead embryos showed a tendency to increase but the pattern was not systematic. (TCO)

22693 STUDIES ON THYROID CANCER INDUCED BY A-BOMB EXPOSURE AND ITS CLINICAL CHARACTERISTICS. Shigemitsu, Takao (Hiroshima Univ.). Med. J. Hiroshima Univ., 13: 665-92(Nov.-Dec. 1965). (In Japanese).

Results are summarized from studies on thyroid cancer in residents of Hiroshima exposed to radiation from the atomic bomb in 1945. The clinical characteristics of the cancers are described. (TCO)

22694 POST-RADIATION RESTORATIVE PROCESSES ON THE LEVEL OF THE ORGANISM, TISSUES, AND CELLS. Zedgenidze, G. A. (Inst. of Medical Radiology, Moscow). Med. Radiol., 10: 5-17(Aug. 1965). (In Russian).

The character and degree of radiation damage to organs and tissues depend on the dose, the dose distribution with time, and the sensitivity of the organism. Radiation damage to an organism is followed by recuperative processes. The postradiation recovery period requires a long period of time. Even if full recovery from radiation damage is observed clinically, the imposition of an additional stress such as burning, wounding by mechanical means, or loss of blood indicates that the recovery from radiation damage is not complete in every respect. Significant functional changes can be detected for a long period of time after the irradiation. With local irradiation the recovery process is much faster than with whole-body irradiation. The number of chromosomal aberrations decreases with decreasing dose rate in animals being given a total dose of 150 R over different intervals of time. The number of pathological mitoses depends on the duration of the irradiation period. The rate of recovery always depends on the physiological state of the organism as a whole. Part of the radiation damage is always irreversible. (TTT)

22695 NEW INVESTIGATIONS ON THE CLINICAL EMPLOYMENT OF WHOLE-BODY IRRADIATION AND BONE MARROW TRANSPLANTATION. Mathe, G. Med. Radiol., 10: 32-9(Aug. 1965). (In Russian).

The transplantation of hematopoietic allogenic cells was observed in grown animals who were suffering from myelo-lymphoid aplasia as a result of a lethal dose of whole-body irradiation. Bone marrow recovery was observed in five patients who had accidentally received a mixed gamma and neutron dose exceeding the lethal dose by 75%. These patients did not develop a secondary reaction because of the temporal nature of the transplantation. Ten patients with leukemia were given a whole-body dose of 800 rads with subsequent transfusion of allogeneous bone marrow. Blood studies showed that the transplantation was successful after the patients recovered from the secondary reaction. In animal studies it was shown that the immunologically competent cells could react against leukemic cells. However, a disadvantage was that the animals frequently died from the secondary reaction against normal antigens. It was observed that the animals developed a tolerance towards other tissues and organs. This tolerance is now an object of study of kidney transplants in dogs. It was possible to ameliorate the secondary sickness in animals by the use of bone marrow from a number of donors. The cells of the most suitable donor were selected spontaneously. In spite of the unresolved questions and practical difficulties, progress in this field is continuing. (TTT)

22696 RADIATION CANCEROGENESIS AND THE PROBLEM OF RESTORATION. Moskalev, Yu. I.; Streltsova, V. N. Med. Radiol., 10: 40-7(Aug. 1965). (In Russian).

The frequency of occurrence of osteosarcomas and leukemia in rats was investigated after successive injections of ^{90}Sr, ^{144}Ce, and ^{239}Pu over various time periods varying from a daily injection to an injection each 4 months. Out of a total of 526 rats, osteosarcomas were found in 99 rats, and leukemia was diagnosed in 32 cases. The frequency of occurrence of leukemia did not change with increased time of administration of a given amount of activity. On the other hand the frequency of occurrence of osteosarcomas decreased with increasing time of administration. Thus, on introducing a total of 102 μC of ^{144}Ce into a rat in five shots once a week, once each 2 weeks, and once each four weeks, the percentages of osteosarcomas were 60, 40, and 31% respectively. With ten shots the percentages were 45%, 33%, and 0% respectively. Similar results were obtained with ^{90}Sr. With the alpha emitter ^{239}Pu, fractionation of the dose resulted in an increase in the frequency of occurrence of osteosarcomas. Thus, a single injection of 1.25×10^{-3} μC of ^{239}Pu/g gave a 3% frequency of osteosarcomas. The same amount of ^{239}Pu injected daily over a period of 50 and 100 days gave osteosarcoma frequencies of 14.2 and 11.1% respectively. With weekly intervals between shots this frequency increased to 21.4%. The more differentiated tumor forms were found in those cases where the dose to the bone tissue was low. (TTT)

22697 RESTORATIVE PROCESSES AFTER IRRADIATION AND THEIR RELATION TO RADIATION LEUKEMIA. Svyatukhin, M. V.; Sorokina, Yu. D. Med. Radiol., 10: 47-55(Aug. 1965). (In Russian).

Black mice of the C57 line were given whole-body x ray doses of 150, 550, and 800 R (four 200 R doses at weekly intervals) and the percent decrease in the weight of the thymus gland was determined. With a 150 R dose the weight decreased rapidly to a minimum on the third day, and increased to a normal weight again on the 10th day after irradiation. With a 550 R dose the weight recovery was slower (15th to 30th day after irradiation). With an 800 R dose recovery required one to two months. The

cortical part lost about 75% of its mass, while the medullary part of the thymus lost only about 20% of its mass after being given a whole-body dose of 150 R. These losses were due to a destruction of lymphatic cells. The larger reticular cells were preserved intact. The number of lymphocytes increased by a factor of 10 during the recovery phase. A high mitotic activity was observed even in the presence of a large number of anomalous mitoses. The administration of urethane at a dose of 1 mg/g of body weight increased the radiation effect, and also increased the incidence of leukemia after irradiation. The total number of lymphocytes in the cortical part of the thymus decreased even more with the use of the chemical agent. The mitotic coefficient decreased by a factor of two under these conditions. (TTT)

22698 THE INHIBITION AND RESTORATION OF THE CAPACITY FOR REGENERATION OF THE PERIPHERAL NERVE AFTER IRRADIATION. Strelin, G. S.; Evsyukov, V. I. (Central Scientific Research Inst., Leningrad). Med. Radiol., 10: 67-73(Aug. 1965). (In Russian).

Four series of Wistar rats were irradiated. In series I the rats were given a whole-body dose of 600 R, and local doses of 600, 1500, and 3000 R. The peroneal branch of the ischial nerve was cut out 24 hours after irradiation in the series I group of rats. In the II, III, and IV series the rats were given a local irradiation of 3000 R, and the operation was carried out on the 20th, 60th, and 127th day after irradiation. The tibial nerve remained intact. Paraffin sections of nerve were prepared for histological study. The average density distribution of nerve fibers was determined as a quantitative characteristic of the process of regeneration. The results showed that a whole-body dose of 600 R did not suppress nerve regeneration which was suppressed by local irradiation doses of 1500 and 3000 R. The slow-down in nerve regeneration was due primarily to damage of the connective tissue and not to damage of the nerve cells. (TTT)

22699 GENETIC CONTROL OF THE SENSITIVITY OF MICROORGANISMS TO THE LETHAL EFFECT OF IRRADIATION. Markovich, G. (Paster Inst., Paris). Med. Radiol., 10: 73-8(Aug. 1965). (In Russian).

The data on multiple and cross reactivation of bacteriophages and yeasts, the state of enzymes in irradiated bacteria, and genetic recombination after irradiation are reviewed to indicate a variety of systems, whose genotype controls the radiosensitivity. Two mechanisms can be distinguished. In one the damaged structure is replaced by another simple structure. The second mechanism is based on enzyme recovery, where the damaged structure regains its previous state. Study of this second mechanism seems to be more promising. The evolution of the recovery mechanism is not clear. As an example, it is known that the appearance of dimeric thymine is evidence of damage on the genetic level. Bacteria damaged in this way can repair the damage by elimination of the dimer without DNA synthesis. The presence of a number of enzymes which have been recently discovered is necessary for the recovery process. Other examples are given. (TTT)

22700 REGENERATION OF NERVE CENTERS AND CEREBRAL MEMBRANES AFTER IRRADIATION. Vedrenne, K. Med. Radiol., 10: 79-83(Aug. 1965). (In Russian).

Radioactive ^{198}Au and ^{90}Y were carefully implanted in the thalamus of animals. The first group of 20 dogs and 3 cats were given 0.5 to 40 mc of ^{198}Au, and were killed at intervals varying from a few hours to 3 months. The second group of 20 rabbits and 5 dogs received 40 to 60 mc of ^{198}Au, and a third group received ^{90}Y injections. Histological sections of brain tissue were prepared and examined. With the pure beta emitter ^{90}Y, the destructive changes were localized over a spherical zone having a diameter of 4 to 8 mm depending on the amount of administered isotope. With the mixed beta and gamma emitter ^{198}Au, a wide transition zone was observed between the inner necrotic zone and the unchanged brain tissue. The histological changes in the transition zone were due to gamma radiation from ^{198}Au. In the central zone of total necrosis the dose was about 100,000 R from a 14 mc ^{198}Au source. The dose was estimated to be 14,000 R at 9 mm from the ^{198}Au source. This dose was exclusively due to gamma irradiation. Doses of 4500 and 1000 R were calculated at distances of 11.2 and 24 mm from the ^{198}Au source. These results corresponded to the degree of observed damage to the brain tissue. The evolutionary character of the damage to the brain tissue is detailed. (TTT)

22701 MODIFICATIONS INDUCED BY IRRADIATION ON COLLATERAL LYMPHATIC CIRCULATION. Bobbio, P.; Peracchia, G. (Univ., Parma). Minerva Chir., 20: 306-8(Apr. 30, 1965). (In Italian).

Change in lymph flow as caused by radiotherapy was studied by lymphography in women undergoing postoperative irradiation for breast cancer. The patients had received doses varying from 2000 R to >3500 R after radical mastectomy, and radiography of the lymphatic system of the affected area was conducted with Lipiodol, injected into the dorsum of the hand from 50 days to 5 to 6 months postirradiation. In subjects exposed to 2000 R doses and examined at 7 to 8 weeks, lymphography did not indicate recanalization of the lymphatic system and evidence of collateral circulation persisted. The lower third of the arm still showed signs of edema. More pronounced changes of the lymphatics were seen after 3000 to 3500 R doses, with continuing obliteration of the vessels, and evidence of contraction of acellular scar tissue. Edema of the peripheral skin was considerable. Fibrosis and acellularity of tissue around the lymphatics were accentuated after doses exceeding 3500 R, with consequent blockage of the lymph channels. In general, the magnitude of the dose of radiation was reflected by the alteration of perilymphatic connective tissue and the resultant restriction of lymph drainage. Four stages of postirradiation changes in the lymphatic system, based on histologic finding, are outlined and correlated with these lymphographic studies. (BBB)

22702 CONSIDERATIONS ON A CASE OF LUNG CANCER WITH BONE METASTASES IRRADIATED DURING THE COURSE OF UNKNOWN PREGNANCY. Ferrario, Enrico; Nuvolone, Ugo (Ospedale Maggiore, Novara, Italy). Minerva Ginecol., 16: 733-8(Sept. 15, 1965). (In Italian).

The case history is reported of a normal male inadvertently irradiated during the first month of gestation. Because of recurrent, osteolytic metastases in the sacrum (S_4) following radiotherapy of bronchial carcinomas, she was given irradiation unknowingly at about the first month of gestation. The pregnancy was interrupted on the 249th day and a live, apparently normal, fetus weighing 2450 g and 49 cm long was delivered. The mother died 8 months later of metastatic cancer, but the male infant survived with no evidence of being injured by in utero irradiation. (TCO)

22703 EFFECT OF IONIZING RADIATIONS ON STEM CELLS. Porteous, D. D.; Lajtha, L. G. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Minerva Nucl., 9: 347-51(Nov.-Dec. 1965).

Results are summarized from a number of studies on the effects of various doses of γ and x radiation on the viability of bone marrow stem cells in mice. The effects of erythropoietin and blood transfusions on radiosensitivity are also discussed. It is suggested that the apparent difference between cell-stem response measured after administration of erythropoietin or by colonizing capacity of transplants may be due to two kinds of stem cell populations or due to functional states of the same population in which the various functions recover differently. (C.H.)

22704 LIMITS OF TOLERANCE OF THE HEMATOPOIESIS TO INTERNAL AND EXTERNAL IRRADIATION. Maisin, J.; Dunjic, A. (Institut du Cancer, Louvain, Belg.). Minerva Nucl., 9: 351-6(Nov.-Dec. 1965).

The concept of tolerance of a biological system is given and discussed. The physiological and radiological factors affecting the limits of tolerance of the hemopoietic system

are reviewed. Among the delayed hazards of irradiation the factors influencing the incidence of leukemia are reported. To illustrate the role of the principal factors, experimental data are presented. The role of thymus in relation to the secondary disease and the immunological response of irradiated animals is discussed. (C.H.)

22705 SIGNIFICANCE OF SOME HEMATOPOIETIC CHANGES IN THE ASSESSMENT OF RADIATION INJURY. Oliva, L.; Stuart, C.; Cittadini, G. (Univ., Siena, Italy). Minerva Nucl., 9: 356-65(Nov.-Dec. 1965). (In Italian).

The significance of some radiobiologic tests (histologic injury of the spleen, reduction of the spleen, leukopenia, blood clotting function) was tested experimentally in mice and rats subjected to total-body irradiation with different doses of x ray and to radioprotective measures (cysteine, morphine, DPN, hematophyrin) or sensitized to the effects of radiation hematophyrin or treated with biological restorative preparations (total human placenta extracts). Observation of the histologic injury to the spleen cannot be considered valid as a true test because it is hard to express in easily comparable quantitative values. On the contrary, it is very useful as a general index of the severity and evolutive stage of the lesions induced by radiation, but only in comparison to normal pictures. It is more difficult to employ this method to establish different degrees of injury in a comparison between irradiated but not protected and irradiated radiobiologically protected subjects. The reduction of the weight of the spleen is a very interesting test and shows a broad and well-controllable resolution even though it is possible that the variations of the weight of the spleen are related not only to the direct action of x ray. No correlation was found with the body weight curve nor with the survival rate. Leukopenia is a poorly significant test for an assessment of the bone marrow function, and does not show a correlation with the other tests, especially the mean survival in hours. Investigation of the blood clotting function is a test which supplies useful information as to the degree of protection or sensitization produced by drugs in total irradiation, and sometimes makes it possible to regulate this protective or sensitizing action and may furnish useful information as to the possible site of this action. It is satisfactorily comparable between groups of animals treated in different experimental conditions and can be coherently included in the post-irradiation syndrome and shows a consistent correspondence with the percent values for the survival time in hours. (auth)

22706 RESPONSE OF THE BLOOD FORMING ORGANS TO CONTINUOUS IRRADIATION. Lamerton, L. F. (Inst. of Cancer Research, Sutton, Eng.). Minerva Nucl., 9: 365-71(Nov.-Dec. 1965).

Results are reported from experiments on rats exposed to continuous whole-body x radiation at a dose rate of 50 rads/day which indicate that there is very little accumulation of radiation damage in the erythropoietic system over long periods of time. The data also suggest that one of the mechanisms by which red cell output is maintained under continuous irradiation is by decrease in cell cycle time, allowing a greater number of divisions between stem cell and mature cell. (auth)

22707 ASSESSMENT OF THE RADIOSENSITIVITY OF HEMATOPOIETIC STEM CELLS WITH THE SPLENIC COLONY TECHNIQUE. Silini, Giovanni; Pozzi, Laura Vittoria (CNEN, Rome). Minerva Nucl., 9: 372-6(Nov.-Dec. 1965). (In Italian).

The transplantation of hemopoietic cells of donor animals into hosts irradiated with large doses of x ray causes the appearance in the spleen of these animals of foci of hemopoietic regeneration. The number of these nodules is directly proportional to the number of stem cells in the injected cell suspensions. Inactivation of the cells by ionizing radiation causes a drop in the number of splenic colonies. By applying this technique in mice, inactivation curves were obtained which make it possible to study the kinetics of the inactivation phenomena in blood forming cells accurately. Data are presented that were obtained with bone marrow and embryonic liver cells irradiated in vivo and in vitro with x ray or fast neutrons under different conditions of gas balance. (auth)

22708 IONIZING RADIATION AND THE INTRACELLULAR OXIDATION-REDUCTION STATE. Jamieson, Dana (Cancer Inst. Board, Melbourne). Nature, 209: 361-5(Jan. 22, 1966).

The level of reduced pyridine nucleotides was monitored during and up to 1 hour after irradiation in several organs of the rat in vivo and in ascites cell and thymocyte suspensions in vitro. The kidney and ileum of the rat, and single-cell suspensions of tumor cells from the intraperitoneal cavity of mice, and thymocytes from Canberra black rats were x irradiated. The effects of this irradiation on oxygen tension and fluorescence are shown. The results show the electron-transport chain insensitivity to the x irradiation. The intracellular oxidation-reduction state was virtually unaltered even when massive doses of radiation were administered. Thus it is concluded that changes in respiratory enzyme levels of coenzymes assayed at later times after irradiation appear to depend on other forms of cellular damage and are not a primary radiation lesion. (J.F.P.)

22709 FACTORS INFLUENCING THE STAINING OF HISTONES IN IRRADIATED RAT THYMOCYTES. Whitfield, J. F.; Youdale, T. (EURATOM, Ispra, Italy). Nature, 209: 730-1(Feb. 12, 1966).

Preparation of x-irradiated rat thymocytes for study of changes in the histones is described. It was concluded that the optimal procedure for investigating the histone changes in radiation-damaged cells with the fast-green technique of Alfert and Geschwind requires that the stained cells be mounted in an aqueous mounting medium and that dehydration with alcohol and xylol be avoided. The shrinkage of the nucleus by dehydration is largely responsible for the false impression that pycnotic nuclei are severely condensed and hence heavily stained. Dehydration further extracts the stain from cytoplasmic structures containing basic proteins, a misleading phenomenon, for basic proteins in the perinuclear fibrillar structures can be strongly stained with alkaline fast-green provided the cells are mounted in an aqueous mounting medium. (H.G.D.)

22710 INTERPHASE DEATH AND RELATED BIOCHEMICAL RADIATION EFFECTS IN MURINE LEUKAEMIA CELLS. Klouwen, H. M.; Appelman, A. W. M.; de Vries, M. J. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Nature, 209: 1149-50(Mar. 12, 1966).

Observations on cytological and biochemical changes and measurements of oxidative phosphorylation at intervals after whole-body x irradiation were used to establish the mode of death of mouse lymphosarcoma cells and myeloid leukemia cells. Observations were also made on leukemic spleens in which the majority of the cells were leukemic. Results suggested that the pattern of biochemical changes was specifically related to the mode of cell death after irradiation. A biochemical basis for interphase death of cells is postulated. (C.H.)

22711 IMMEDIATE EFFECTS OF PROTONS ON THE MAMMALIAN BRAIN. Nystroem, Stig H. M. (Massachusetts General Hospital, Boston. Univ. Central Hospital, Helsinki). Naturwissenschaften, 53: 159(1966).

Cytological effects of proton irradiation were studied in brains of mice head-irradiated with doses varying from 1000 to 20,000 rads. Using electron microscopy, extensive intercellular and perivasal edema was evident in animals receiving doses of 9000 rads or more. The fluid had almost the same electron density as blood plasma. No immediate lesions of the lipid layers of the axon sheaths were visible. A disturbance in the osmotic balance of various structures seemed to be the principal initial sequel of irradiation. (H.G.D.)

22712 THE RELATIONSHIP BETWEEN THE OXYGEN CONSUMPTION OF VARIOUS TISSUES AND THE RADIOSENSITIVITY IN MICE. I. OXYGEN CONSUMPTION OF VARIOUS TISSUES IN THE NORMAL PHYSIOLOGICAL STATE OF MICE. Tsuchiya, Takehiko (National Inst. of Radiology Sciences, Chiba, Japan); Okamoto, Kazuo. Nippon Acta Radiol., 25: 860-4(Oct. 1965). (In Japanese).

In vitro measurement of oxygen consumption was carried out by an oxygraph instrument in the various tissues

of three strains of mice showing different radiosensitivities: C57BL/6 (606R), RF (540R), and CF #1 (510R). In any strain the oxygen consumption, Qo_2 value, was observed to decrease in the order of kidney, small intestine, brain cortex, liver, spleen, and thymus, except that in liver and brain cortex of C57BL/6 mice the order was inverted. The Qo_2 value in any tissue among these strains was observed to be lowest in C57BL/6 and to become higher in the order of RF and CF #1. This order agrees completely with radiosensitivity in these strains observed previously by $LD_{50/30}$. (auth)

22713 COMPARATIVE INVESTIGATION ON RADIOBIOLOGICAL RESPONSES OF MURINE EHRLICH ASCITES TUMOR CELLS IN VITRO AND IN VIVO. **Kano, Eiichi (Kyoto Univ.). Nippon Acta Radiol., 25: 1007-12(Nov. 1965). (In Japanese).**

Radiation responses of murine Ehrlich ascites tumor cells were compared in vitro and in vivo. A diffusion chamber method was adopted for the cell culture in vivo, while a usual tissue culture method was used in vitro. The cells were prepared from the same in vitro culture; the inoculation period was not long enough to reduce the selection pressure, if any, among the cells within the diffusion chamber; and the conditions of the two culture systems were arranged to give similar growth rates. Different dose-effect relationships were observed between the two culture systems. The extrapolation number in vivo appeared to be larger than that in vitro, whereas D_0 values were similar in the two systems. The difference in radiation responses between in vitro and in vivo, the characteristics of the diffusion chamber method as an in vivo culture technique, and the relationship between the numbers by colony formation method and those by cell count method as the criteria in the studies of the survival fraction from x irradiation are discussed. (auth)

22714 AGAR DIFFUSION TEST WITH ULTRAVIOLET-IRRADATED BARLEY STRIPE MOSAIC VIRUS. **Murayama, Daiki; Yokoyama, Tatsuo (Hokkaido Univ., Japan). Nippon Shokubutsu Byori Gakkaiho, 30: 216-18(Sept. 1965). (In Japanese).**

The Ouchterlony gel diffusion technique was used to examine precipitation zones appearing in agar plates having circular reservoirs filled with ultraviolet-irradiated barley stripe mosaic virus (BSMV) and its homologous antiserum. When the virus was exposed to ultraviolet radiation for 1 hour, no change was recognized in the antigenicity either in flocculation tests or in gel diffusion tests. Two hours of exposure caused a little decrease, and 3 hours of exposure caused more decrease in the antigenicity. After 6 hours of irradiation, a slight reaction was observed in the flocculation test, but no visible precipitation zone could be detected in the gel diffusion test. The antigenicity was lost after 7 hours of irradiation. The position of the precipitation zones appeared nearer to the midpoint between the antigen and antiserum reservoirs when BSMV was exposed to radiation for 2 to 5 hours. When the dose of irradiation was increased to 5 hours, the position of the precipitation zones shifted further away from the antigen reservoir, and the curvature of the precipitation zones became smaller than in the case of untreated virus suspensions. It was after 2 hours of irradiation that the clearest zones were usually observed, although 3 hours of treatment also resulted in clear zones. Virus preparations irradiated for 6 hours showed no visible zone, despite positive reaction in the flocculation test. It was supposed that the formation of precipitation zones was strongly enhanced by the ultraviolet irradiation of the virus, because the virus particles were cut into fragments by irradiation so that they diffused faster in the agar gel than the untreated virus. (auth)

22715 OSTEORADIONECROSIS OF THE JAW. **Uotila, Esko; Westerholm, Nils (Univ. of Helsinki). Odontol. Tidskr., 73: 239-49(Apr. 15, 1965).**

The literature is reviewed and six cases of osteoradionecrosis of the jaw are presented. Osteoradionecrosis was established in each of the cases following dental extraction during or soon after radiotherapy. Nutrition was extremely poor in the necrotic area, in which partial resection of the mandible was performed. It seemed that the magnitude of the radiation dose was not in itself of major significance in the genesis of osteoradionecrosis. Generally, a latent period of 2 yr was observed. Infection appeared to be an important etiologic factor in the development of osteoradionecrosis in the area, since infected teeth were extracted in every case. Precautions for avoiding infection when dental radiotherapy becomes necessary are discussed. (TCO)

22716 CLINICAL EVALUATION OF RADIOTHERAPY FOLLOWING ORAL CANCER. FIRST REPORT: ON THE QUESTION OF RADIOTHERAPY AND STOMATITIS. **Okuhara, Seiyuh; Tsunemoto, Hikoshi; Kono, Tamakoji (National Hospital, Kanazawa, Japan). Oral Surg. (Jap.), 6: 349-57(1960). (In Japanese).**

Development of radioinduced stomatitis in patients undergoing ^{60}Co treatment of oral cancer is reported. Thus in 6 among 9 cases of oral cancer receiving radiotherapy in the National Kanazawa Hospital, the ^{60}Co γ-irradiation doses didn't reach the planned tumor dose owing to the development of radiation stomatitis. Appearance of third degree (relatively mild) radiation stomatitis, the so-called reactive stage, occurred after fairly low doses over a wide range from 600 to 2600 R. The transitional period to first degree radiostomatitis was 3 to 7 days, which is characterized by ulcerative inflammation, seen after tumor doses of 2000 to 3000 R. In cases in which development of radiostomatitis prohibits administration of the planned tumor dose, Ra needles, ^{198}Au implants, or Rn seeds were used to increase the interstitial tumor dose. (TCO)

22717 THE EFFECTS OF LASER RADIATION ON TEETH, DENTAL PULP, AND ORAL MUCOSA OF EXPERIMENTAL ANIMALS. **Taylor, Richard; Shklar, Gerald; Roeber, Fred (Tufts Univ., Boston). Oral Surg., Oral Med., Oral Pathol., 19: 786-95(June 1965).**

The effects of varying laser intensities were studied on the teeth and oral mucosa of hamsters. Six animals received radiation of 35 J, and six animals were irradiated with a beam of 55 J. Degenerative changes in the teeth and tongue are described. Preliminary findings suggest that the use of laser energy for operative procedures on teeth and oral mucosa presents many problems. Shielding can be used to prevent damage to tissues and teeth surrounding the focal point. (TCO)

22718 A STUDY ON RECONSTRUCTION OF THE URINARY BLADDER SUBJECTED TO REGENERATION FOLLOWING HOMOGRAFT. **Sakai, Hiroshi (Osaka City Univ.). Osaka Shiritsu Daigaku Igaku Zasshi, 13: 107-23(Mar. 1964). (In Japanese).**

In exploratory studies on surgical repair and reconstruction of the bladder carried out in dogs, x radiation was used to suppress the homograft reaction in the recipient animals. In initial studies, homologous bladders were transplanted to recipient dogs that had undergone total cystectomy. Six of the 20 dogs developed necrosis of the transplanted bladder and died of peritonitis, from urine leaking into the peritoneum. Postmortem examination showed that regenerated tissue developed outside the bladder wall within a week but this tissue was very susceptible to rupture from slight trauma. Another group of 20 dogs was similarly operated and provided with homologous bladder, and in addition received 400 R/kg body wt of whole-body irradiation one week before grafting was attempted. In this group there was no leakage of urine into the peritoneum, and, consequently, no peritonitis. Gross and histologic studies revealed regenerative changes in the bladder wall, with a 2-mm thickness of new tissue which was not so susceptible to injury and rupture. Thus, before the homograft was eventually rejected, an entire new bladder was regenerated and became covered with epithelium. This regenerated pouch showed no evidence of atrophy three months later, suggesting the possible clinical value of this technique. (BBB)

22719 COMPARISON OF BIOLOGICAL EFFECTS OF RADIATION OF DIFFERENT ENERGIES. REPORT 1.

COMPARISON OF BIOLOGICAL EFFECTIVENESS OF 15 Mev ELECTRON BEAMS AND 200 kv X-RAYS ON THE EHRLICH ASCITES TUMOR CELLS. Ocehi, Hironobu (Osaka City Univ. Graduate School). Osaka Shiritsu Daijaku Igaku Zasshi, 14: 565-78(Dec. 1965). (In Japanese).

The effect of irradiation on a dry mass of the Ehrlich ascites tumor cells was studied with an interference microscope. While irradiation with a dose of 50 R to 100 R in vivo caused no marked effects on the dry mass, irradiation with a dose of 300 R, 500 R, or 1000 R caused a considerable increase in the dry mass. The increase started from 6 to 12 hours after irradiation, showing further increase in 48 hours. The more the radiation dose, the more increase in the dry mass was observed 24 hours after irradiation. Fifteen Mev electron beams and 200 kv x rays produced no qualitatively different effect, but 15 Mev electron beams produced less marked increase in the dry mass than by 200 kv x rays. A statistically significant difference in the amount of the dry mass following irradiation with 15 Mev electron beams and 200 kv x rays was observed. The increase in the dry mass was studied in reference to mitotic activity. The amount of the dry mass increased during a mitotic delay maintaining a high level for 48 hours. Correlations between the dry mass of tumor cells and mitotic activity are discussed. (auth)

22720 ON THE ROLE OF HUMORAL FACTORS IN THE CHANGES OF THE CENTRAL NERVOUS SYSTEM IN EXPERIMENTAL RADIATION DISEASE. Gorizontov, P. D.; Scherbova, E. N. Patol. Fiziol. Eksp. Terap., 7: 14-19(Jan.-Feb. 1963). (In Russian).

Experiments were conducted on single and parabiotic rats, joined by connecting cutaneous-muscular tissue head to head in the area of the cerebral cortex. For comparison, single and parabiotic rats were subjected to whole-body x irradiation at a dose of 1100 R, while two other single rats and one partner of the parabiotic pairs received 25 R diffuse irradiation in a box constructed to shield them during irradiation of their partner. Contrary to expectation, the parabiotic rats irradiated with 1100 R showed more marked electroencephalographic (EEG) changes than did the single rats receiving 1100 R, even though the parabiotic rats displayed less pronounced changes of the general condition and survived longer. Irradiation of individual rats with 25 R caused little change in the activity of the cerebral cortex. However, irradiation of the parabiotic rats with 25 R, under the same conditions, caused significant EEG changes, which resembled the EEG changes of the irradiated partner (dose of 1100 R). These results indicate that humoral changes play an important role in the central nervous system disturbances in irradiated animals. (BBB)

22721 DELAYED PIGMENTATION AND ULTRAVIOLET ERYTHEMA. van der Leun, J. C. (State Univ., Utrecht). Photochem. Photobiol., 4: 459-64(June 1965).

Data indicating the nature of the relation between uv-induced erythema and delayed pigmentation are discussed. The location of the pigmentation with respect to the exposed skin area suggests that the pigmentation is influenced by the preceding vasodilation. Theoretical considerations suggest that uv radiation exerts two distinct erythema effects on the skin: an effect of the radiation directly on the dermis, with a smooth action spectrum through the whole uv region and a flat max at 250 nm; a more effective specific action on the epidermis by radiation in a narrow wavelength region near 300 nm. The idea of the two distinct actions may explain why the gradation of the erythema was found to be steeper in case of albinism than for normally pigmented skin. Apparently the faint effects were epidermal and the severe effects dermal. Thus, the influence of the pigmentation on the sensitivity of the skin to uv radiation of different wavelengths appears to support the hypothesis of two distinct erythema effects of uv radiation. This leads to an integration of some long-known phenomena in theoretical considerations of the origin of uv erythema. (BBB)

22722 OBSERVATIONS ON ULTRAVIOLET ERYTHEMA. van der Leun, J. C. (State Univ., Utrecht). Photochem. Photobiol., 4: 447-51(June 1965).

Ultraviolet erythemas elicited on human skin with 250-nm and 300-nm radiation were compared. Two features were investigated: the lateral extension of the erythema beyond the boundaries of the exposed skin area, and the skin temperature associated with the erythema. In both respects, marked differences were found between the two types of erythema. The 300-nm erythema, if sufficiently intense, showed a sharp rise of the skin temperature; the 250-nm erythema did not. The possibility of completely different origins for these two types of uv erythema is considered. (TCO)

22723 IRRADIATION OF LABELED CELLS. APROPOS OF THE ABSORBED DOSE IN CELLS LABELED WITH ^{51}Cr AND OTHER RADIOACTIVE TRACERS. Doroszewski, Jan. Pol. Przegl. Radiol. Med. Nuklearnej, 30: 97-103(1966). (In Polish).

The absorbed radiation dose in cells labeled with ^{51}Cr- and thymidine-^{3}H was estimated. It was demonstrated that the dose is smaller in the cells labeled with ^{51}Cr. Some physical data that are helpful in the evaluation of the radiation dose absorbed by cells labeled with ^{32}P and ^{14}C are included. (auth)

22724 RELATION OF EMBRYONIC AND FETAL X IRRADIATION TO LIFETIME AVERAGE WEIGHTS AND TUMOR INCIDENCE IN MICE. Rugh, R.; Duhamel, L.; Skaredoff, L. (Columbia Univ., New York). Contract AT-30-1)-2740. Proc. Soc. Exp. Biol. Med., 121: 714-18 (Mar. 1966).

Control or normal male CF1 mice show lifetime average weights in excess of comparable CF1 females. Exposure of the CF1 mouse embryo or fetus at various stages to 100 R x-rays reduces its lifetime average weight significantly below the parallel controls, particularly for the males. The month at which the peak weight was reached varied for the sexes, being 12 to 15 for the males and 13 to 30 for the females, suggesting greater variations in response of the females to growth inhibition by x-irradiation of the embryonic stages. Exposure to 100 R on gestation days 11, 12, and 13 had the greatest effect on reducing the average weight of both males and females. This is the period of greatest skeletal growth activity. Tumor incidence was higher among the females than among the males (4 to 1 ratio) among those x-irradiated in utero. Tumor incidence among the controls was low, but even there the incidence was higher among the females. The evidence for any increment in tumorigenesis following embryonic or fetal x-irradiation was equivocal. The long time sequelae of embryonic and fetal radiation relate to growth and total body weight (permanent stunting) more than to tumorigenesis. (auth)

22725 THE RADIATION-TREATED LUNG. Ledoux-Lebard, Guy; Laurent, Yves. Progr. Med. (Paris), 92: 791-8(Dec. 10, 1964). (In French).

The radiation-treated lung represents a complication of irradiation treatment of mammary cancer or cancer of the esophagus. It rarely appears after treatment of bronchial cancer because the treatment is relatively brief. It is rare in treatment of radiosensitive mediastinal adenopathies, such as Hodgkins disease or lymphosarcomas. Radiological signs of the radiation-treated lung include cloudy opaquities with a portion of the affected lobe, consisting of micronodular and reticular patterns, macronodular patterns resembling ulceronodular tuberculosis in the region of the mediastinum. These complications can be avoided by reducing the irradiation to which the lung is exposed. Technical conditions such as orientation and dimensions of the field, dose, and exposure time play a large role in lung radiotherapy. The apex is particularly affected in the anterior, posterior, and axillary fields. During irradiation of the mammary gland in the tangential field, irradiation of the lung is almost completely avoided. The wavelength and the penetration of the radiation to each have great importance. Cobalt-60 provides a means to administer a large tumor dose, with limited dose to the skin surface. A combination of telecobalt therapy and x irradiation could reduce the treatment dose considerably. (BBB)

22726 EFFECT OF WHOLE-BODY X IRRADIATION ON RENAL COMPENSATORY HYPERTROPHY. Threlfall, G.; Cairnie, A. B.; Taylor, D. M.; Buck, A. T. (Inst.

of Cancer Research, Surrey Branch, Eng.). Radiat. Res., 27: 559-65(Apr. 1966).

The weight and DNA content of the right kidneys of left unilaterally nephrectomized female C57 black mice were compared with values obtained for the left kidneys removed at operation 21 days earlier. In unirradiated operated animals the increases in weight and DNA content of the right kidney were approximately 56% and 27%, respectively. In animals given 600 or 700 R of whole-body x irradiation the increase in both these parameters was significantly reduced, to approximately 30% and 15%, respectively. The magnitude of the effect of the radiation dose on the kidney was not dependent on the operation-irradiation interval within 18 hours before and 51 hours after operation. When the weight and DNA content of the right kidney were expressed per unit of body weight of the animal, there was no real difference between the values for irradiated and unirradiated animals. This indicated that the reduction in kidney hypertrophy observed in the irradiated animals was due at least partly to an overall depression of growth of the animals. By autoradiography with tritiated thymidine as label it was found that at all operation-irradiation intervals the kidneys of irradiated animals, examined at 2 days after operation, exhibited less DNA synthesis when compared with operated unirradiated animals. At 4 days postoperation the difference was even more marked. By 21 days, the net increase in DNA content of the irradiated kidneys indicated a recovery of DNA synthetic ability. (auth)

22727 PLASMA CORTICOSTERONE LEVELS AFTER FAST NEUTRON EXPOSURE IN BURROS. **Haley, Thomas J.; Komesu, N.; Brown, Daniel G. (Univ. of California, Los Angeles. UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Radiat. Res., 27: 566-9(Apr. 1966). (UCLA-12-566).**

Fast neutron irradiation with doses varying from 100 to 440 rads caused a marked increase in plasma corticosterone levels at 1 hour postirradiation. Whole-body irradiated animals returned to control levels in 24 hours, whereas the body-only irradiated animals showed a secondary significant rise at 48 hours. (auth)

22728 ON THE POPULATION KINETICS OF THE ROOT MERISTEM OF VICIA FABA EXPOSED TO CONTINUOUS IRRADIATION. **Hall, Eric J.; Oliver, Raymond; Shepstone, Basil J.; Bedford, Joel S. Radiat. Res., 27: 597-603(Apr. 1966).**

The growth rate of bean roots was observed for several weeks under continuous γ irradiation at low dose rates; half of the roots were grown at 19°C, the remainder at 12°C. The intermitotic cycle time for roots grown at 19°C is approximately half that for roots cultured at 12°C; it was found that about twice the dose rate was required to produce a given reduction in growth rate for roots at the higher compared with the lower temperature. These data support the hypothesis that it is dose per cell cycle that determines the degree of damage produced in a population of dividing cells exposed continuously to radiation. (auth)

22729 EARLY EFFECTS OF BETA IRRADIATION ON DERMAL VASCULAR PERMEABILITY TO PLASMA PROTEINS. **Song, Chang Won; Anderson, Robert S.; Tabachnick, Joseph (Albert Einstein Medical Center, Philadelphia). Radiat. Res., 27: 604-15(Apr. 1966).**

Vascular changes in guinea pig skin after β irradiation with a $^{90}Sr-^{90}Y$ sealed source were studied by injection of ^{125}I-labeled serum albumin. There was a progressive increase in intravascular plasma volume which reached a maximum, 124% of the control, at 18 hours and persisted for 48 hours after 3000 rep of β irradiation. A biphasic increase in the transfer rate of plasma protein from blood vessels into extravascular space in epidermis and dermis was evident by 24 hours in 3000 rep of β-irradiated skin. The first peak increase in epidermis and dermis of 36% and 17%, respectively, occurred 3 hours postirradiation; this was followed by a decline to almost the control level and a second peak increase of 84% in epidermis and 37% in dermis at 18 hours. Eighteen hours after 3000 rep of β irradiation, plasma protein accumulation in dermis and epidermis was 2.2 and 3.7 times that in the control area, but there was no significant difference between irradiated and control skin at 48 hours. Some increase in plasma protein accumulation was also observed at 18 hours after 500 and 1000 rep of β irradiation. The data indicate that β irradiation with a single skin surface dose of 500 to 3000 rep causes an immediate increase in intravascular volume as well as vascular permeability to plasma protein. (auth)

22730 EFFECT OF STRAIN AND DIET ON THE THIRTY-DAY MORTALITY OF X-IRRADIATED GERM-FREE MICE. **Walburg, Harry E. Jr.; Mynatt, Edna I.; Robie, D. M. (Oak Ridge National Lab., Tenn.). Radiat. Res., 27: 616-29(Apr. 1966). (ORNL-P-1372).**

Germfree and conventionally reared mice of the inbred RFM and noninbred ICR and CF No. 1 strains were exposed at about 100 R/min to 500 to 1000 R of whole-body x rays (half-value layer 1.0 mm Cu). In each strain, germfree mice had a higher $LD_{50(30)}$ than their conventional counterparts, but the difference in $LD_{50(30)}$ between germfree and conventional mice varied with strain from 147 R for RFM males to 34 R for CF No. 1 mice. The $LD_{50(30)}$ of different strains varied only one-half as much in germfree mice as in conventional mice, and the order of strain radiosensitivity was different for conventional and germfree mice. Supplementation of the autoclaved diet with a filter-sterilized synthetic diet increased the $LD_{50(30)}$ of germfree ICR mice from 790 to 900 R, changed the slope of the mortality curve and the mean survival time, and decreased weight loss after irradiation. (auth)

22731 EFFECT OF TEMPERATURE ON THE RATE OF RECOVERY FROM RADIATION-INDUCED DAMAGE IN THE FISH ORYZIAS LATIPES. **Egami, Nobuo; Etoh, Hisami (National Inst. of Radiological Sciences, Chiba, Japan). Radiat. Res., 27: 630-7(Apr. 1966).**

In the fish Oryzias latipes, a dose of irradiation is less effective if applied in two fractions at an interval than the same total dose given by a single exposure. A group of Oryzias received a single irradiation with 100 kR of γ rays, and seven other groups received two irradiations with 50 kR at intervals of different length. Another group of fish was given a single dose of 4 kR of x rays, and four other groups were exposed to 2 kR doses at intervals. Fourteen other groups were irradiated with 2 to 4 kR of x rays. If the interval between the two divided doses was 3 days or longer at the temperature of 23°C, the lethal effect of irradiation decreased. However, division of doses was not effective in reducing noxious effects of irradiation if the interval between the two doses was 1 day or shorter, or if the temperature during the interval was 11°C or lower. From these results, it seems likely that in fish exposed to two fractionated doses recovery from radiation-induced damage proceeds to some extent during the interval between the two irradiations, and that the rate of recovery is slowed down at low temperature. (auth)

22732 COMPARATIVE EFFECTS OF CYCLOPHOSPHAMIDE, NITROGEN MUSTARD, AND TOTAL-BODY IRRADIATION ON SURVIVAL AND ON WHITE BLOOD CELLS IN RATS. **Hoest, Herman (Norwegian Radium Hospital, Oslo). Radiat. Res., 27: 638-51(Apr. 1966).**

The effect in rats of cyclophosphamide, HN2, and total-body x irradiation on survival, weight response, and white blood cells was studied. After the LD_{50} dose, death occurred about 1 week earlier after HN2 than after cyclophosphamide or radiation, probably because the gastrointestinal tract and brain tissue are more susceptible to HN2 than to cyclophosphamide or radiation. The lymphocyte response to the different treatments was in principle the same, in contrast to the differences in the granulocyte response. Thus, after the initial granulocytopenia an overshooting granulocytosis occurred in the drug-treated animals. This granulocytosis increased with increasing dosage. In contrast, the granulocytes increased only temporarily to subnormal values during recovery in the irradiated animals, and this temporary rise in the granulocytes was less pronounced with increasing radiation dosage. The response to bacterial vaccine intravenously injected indicates differences in the magnitude of the extravascular granulocyte reserves after the drugs and x irradiation. (auth)

22733 ULTRASTRUCTURAL STUDIES OF DELAYED CHANGES IN THE KIDNEY OF THE MOUSE IRRADIATED AT BIRTH. Guttman, Paul H. (Univ. of California, San Francisco). Radiat. Res., 27: 652-68(Apr. 1966).

Electron microscopic studies were made of the mouse kidney 35, 90, and 150 days after x irradiation (450 rads) on day of birth. The principal changes consisted in an initial increase in cellularity of the mesangium, followed by an increase in mesangial matrix, and progressive thickening of the basement membranes of the glomerulus. In late stages, collagen appeared in the thickened mesangial matrix and in the inner layers of the basement membranes. Deposition of electron-dense amorphous material occurred in the inner portion of the basement membrane and in the matrix. The significance of these changes is discussed. (auth)

22734 INFLUENCE OF PARTIAL-BODY X IRRADIATION ON DEVELOPMENT OF PHOSPHOROTHIOATE OXIDASE IN THE LIVERS OF MALE RATS. Hietbrink, Bernard E.; DuBois, Kenneth P. (Univ. of Chicago). Radiat. Res., 27: 669-75(Apr. 1966).

A study was conducted in young male rats to determine the influence of partial-body shielding on the x-ray-induced inhibition of the development of an enzyme in liver microsomes that catalyzes the oxidative desulfuration of Guthion. Shielding the liver and testes areas did not prevent the inhibitory effect of 200 R of x ray on the development of enzyme activity. The inhibitory effect of this dose was substantially reduced by shielding the head and testes areas or the head and liver areas during the exposure period. Administration of 200 R to the head area, while the remainder of the body was shielded, inhibited the development of enzyme activity to a degree similar to that caused by 200 R of total-body x irradiation. The same dose of irradiation did not inhibit the enzyme development in hypophysectomized weanling rats. Thus, the pituitary is necessary for the radiation effect, but involvement of the pituitary is not the result of a radiation-induced deficiency of pituitary hormones. (auth)

22735 EFFECT OF ENDOTOXIN ON KINETICS OF HEMOPOIETIC COLONY-FORMING CELLS IN IRRADIATED MICE. Smith, Willie W.; Brecher, George; Fred, Sallie; Budd, Roger A. (National Insts. of Health, Bethesda, Md.). Radiat. Res., 27: 710-17(Apr. 1966).

The loss and subsequent recovery of transplants of hemopoietic colony-forming units was studied in mice irradiated with 400 rads of ^{60}Co, with no treatment or injected with 25 μg of S. typhosa endotoxin either a day before or shortly after irradiation. The major effect of the endotoxin was to move forward the time at which effective production of stem cells was resumed. In pretreated animals this amounted to 2 to 3 days, and in animals treated after irradiation to 1 to 2 days. Once mitosis had begun, the cell cycle was not shortened. The effect on colony-forming units appeared to be somewhat greater for spleen than for femur, particularly in the case of postirradiation treatment. (auth)

22736 EVIDENCE OF OVER-RECOVERY IN THE IRRADIATED CHICK. Stearner, S. P.; Tyler, S. A.; Sanderson, M. H. (Argonne National Lab., Ill.). Radiat. Res., 27: 727-32(Apr. 1966).

In the 3-day chick, at least two distinctly different processes influence the increase in tolerance to γ radiation within 24 hours after a conditioning exposure. Recovery processes act to reduce radiation effects. A radiation-induced resistance may result in an acquired tolerance greater than the inherent tolerance to ionizing radiation of unirradiated chicks. (auth)

22737 EFFECT OF FRACTIONATED RADIATION THERAPY ON PLASMA VOLUME AND RED CELL MASS IN HUMANS. Levitt, S. H.; Bogardus, C. R. Jr.; Wood, G. A.; Ficken, V. J. (Univ. of Oklahoma, Oklahoma City). Radiol. Clin. Biol., 34: 347-56(1965).

Thirty patients receiving radiation therapy had serial studies made of the red cell mass and plasma volume through a course of therapy and one month follow up. Most patients had no significant change. Seven patients had a relatively consistent decrease in red cell mass with a subsequent rise at the end of therapy. They also had what appears to be an initial increase in plasma volume and subsequent decrease. These changes were found in selected patients, most of whom had carcinoma of the lung, multiple large fields irradiated to high doses, or thoracic irradiation. The number of patients observed was small and further confirmation of these findings will be necessary. (auth)

22738 EXPERIMENTAL ASPECTS OF LEUKEMIA INDUCTION AND INHIBITION IN MICE BY X IRRADIATION. Berenblum, I.; Trainin, N. (Weizmann Inst., Rehovoth, Israel). Radiol. Med. Nucl. (Caracas), 4: 33-8(July-Dec. 1964). (In Spanish).

Factors influencing radioinduced and spontaneous leukemogenesis in mice are reviewed. Parameters considered include: strain, sex, age, the thymus, viruses, urethan, and tissue transplants. Three hypotheses are proposed: that the transmissible factor is a virus liberated through irradiation; that the transmissible factor, liberated after single irradiation might be similar to a virus, although yet in an inactive state, and its eventual transformation into a leukemogenic virus will be promoted through the presence of urethan; and that the transmissible factor represents a latent tumor cell that the urethan subsequently changes into a leukemic cell. Further tests using sheep spleen fractions in various forms of supernatants, homogenates, and precipitates furnished evidence of the existence of a cell-free factor in the spleen of sheep that is capable of inhibiting leukemia. (TCO)

22739 RENAL LESIONS PRODUCED BY THOROTRAST. Van Lancker-Delvigne, M. A.; Smoliar, V. (Univ., Liege). Rev. Belge. Pathol. Med. Exp., 31: 271-9(Aug. 1965). (In French).

A kidney was removed from each of four patients who had received ThO_2 for pyelographic studies made 14 to 26 yr previously. Two of the patients showed evidence of renal fibrosis and scarring in the mucosa of the pelvis and calyces. The other two patients showed evidence for malignant changes in the urinary mucosa. The tumors observed originated in the region of the renal calyces where large quantities of ThO_2 were deposited. One was an epithelioma, and the other was an invasive carcinoma of the urinary mucosa. (BBB)

22740 IONIZING RADIATION AND LEUKEMIA. Schapira, Isaac (Segunda Catedra de Clinica Medica, Cordoba, Argentina). Rev. Fac. Cienc. Med. Cordoba, 23: 75-81(Jan.-Mar. 1965). (In Spanish).

The role of medical sources of radiation in radioleukemogenesis is reviewed, and leukemogenesis is discussed. Possible sites of cell injury that may be responsible for leukemia development are considered, with an examination of the differential sensitivity of various somatic cells. Statistics which indicate that occupationally exposed persons have an elevated incidence of leukemia are examined. The preponderance of chronic granulocytic leukemia, among the various possible types, in radiation-exposed persons is discussed. Controversial evidence relating to prenatal exposure to diagnostic radiation is examined. The apparent risk of leukemia from in utero exposure is greatly diminished in the later stages of pregnancy. Reports of chromosome aberrations in children exposed to repeated radiodiagnosis are considered in terms of leukemogenesis. (TCO)

22741 IMMUNOLOGICAL COMPETENCE: ALTERATION BY WHOLE-BODY X IRRADIATION AND SHIELDING OF SELECTED LYMPHOID TISSUES. Miller, Joshua (Yale Univ. School of Medicine, New Haven). Science, 151: 1395-6(Mar. 18, 1966).

The spleen and thymus of 6-week-old mice contain similar numbers of lymphoid cells. A lethal dose of x irradiation given to animals whose thymus, midgut, or hindlimbs were shielded at the same time resulted in permanent acceptance of allografts, while a similar dose given to spleen-

shielded mice so irradiated resulted in a normal rejection pattern. The return of immunological competence was related to the state of the lymphoid organs with different types of shielding. (auth)

22742 POPULATION FLUSHING WITH SEXUALLY STERILE INSECTS. Monro, J. (Univ. of Adelaide). Science, 151: 1536-8(Mar. 25, 1966).

In theory, populations of animals can be displaced by overloading a resource with introduced sterile animals. The theory was tested on natural populations of the Queensland fruitfly Dacus tryoni Frogg. Three of four treated populations declined sharply within 2 days after sterile flies were introduced. (auth)

22743 RBE AND DOSE RATE FOR RADIATION EFFECTS IN WHEAT. Matsumura, Seiji (National Inst. of Genetics, Mishima, Japan). Seiken Jiho, 13: 155-9 (Oct. 1962).

Effectiveness of various types of ionizing radiations on wheat seeds in the production of chromosome aberrations was studied. Dry seeds of Triticum monococcum flavescens were soaked in water or ^{32}P and ^{131}I solutions for 1 and 2 days before sowing. Radioactive solutions contained 0.2 to 1.2 mC/g of ^{32}P and 0.8 to 1.6 mC/g of ^{131}I. To compare the β-radiation effects with those of γ rays, other seeds were subjected to a ^{60}Co source at 2, 4, and 6 kR. In general, the effects of γ radiation on chromosome aberrations and gene mutations were unexpectedly small, compared with those of corresponding β radiations from ^{32}P and ^{131}I solutions. Dry seeds of Triticum monococcum, T. durum, and T. vulgare were treated with a thermal neutron flux that ranged from 4.4 to 37.5×10^{12} n/cm^2 sec. Exposure to 14-Mev neutrons was also studied. After exposure to 37.5×10^{12} n/cm^2 sec and 5 krad of fast neutrons, T. monococcum did not germinate, while the seeds of T. durum and T. vulgare germinated but most of the seedlings died in an early stage. At 20.6×10^{12} n/cm^2 sec and 2 to 2.5 krad of fast neutrons, most of the seedlings of T. monococcum died, while in T. durum and T. vulgare slow growth of the seedlings continued. RBE for fast neutrons was estimated as follows: for germination rate 3 to 3.5; for seedling growth 6 to 10; for seed fertility 12 to 20; and for chromosome aberration 8 to 25. Thus, RBE is lower for the characters observed in earlier stages than those of mature plants, especially in polyploids. The RBE of $(\alpha + {}^7Li)$ from the thermal neutron capture reaction $^{10}B(n,\alpha)^7Li$ compared with γ rays was calculated as 10 to 60 for chromosome aberrations and as 30 for chlorophyll mutations. The RBE for x and γ rays was about the same as for seedling height, seed fertility, and mutation rates. (BBB)

22744 X-RADIATION OF SOUTHERN PINE SEED AT VARIOUS MOISTURE CONTENTS. Snyder, E. B.; Grigsby, H. C.; Hidalgo, J. U. (Tulane Univ., New Orleans). Silvae Genet., 10: 125-60(Sept.-Oct. 1961).

Southern pine seeds were x-irradiated to learn how various rates, quantities, and qualities of rays, and their interactions with seed moisture content and pregermination treatment (stratification), affected germination and seedling growth. Possible evidence of radiostimulation was also sought. The species were loblolly pine (Pinus taeda), slash pine (Pinus elliottii var. elliottii), longleaf pine (Pinus palustris), and shortleaf pine (Pinus echinata). In a second experiment, a dose-mortality response in 1-yr survival was obtained when stratified loblolly seeds were irradiated with 200, 400, 600, 800, and 1000 R of x rays. The LD_{50} was ~1000 R. Irradiation did not detectably affect the germination of dry seed, nursery growth of seedlings from dry or stratified seed, or the survival or height-growth of trees from dry or stratified seed. In a third experiment, seeds of longleaf, slash, and shortleaf pine were subjected to various moisture and x-ray treatments. Prestratification for 3 weeks in conjunction with doses of 800 R and above caused significant to highly significant reductions in germination percentages. The LD_{50} averaged 1600 R for the three species. (TCO)

22745 COMPARATIVE INVESTIGATIONS ON THE BIOLOGICAL EFFECTS OF FRACTIONATED X AND ELECTRON IRRADIATION. Hofmann, Dieter (Univ., Muenster, Ger.). Strahlentherapie, 129: 412-20(Mar. 1966). (In German).

Continuing previous studies concerning the effect of fractionation in the administration of high energy radiation, photoelectric measurements of erythema of the skin were done in rats after fractionated x ray and electron irradiation. Dose fractionation as well as duration of the intervals were varied. Total doses for x rays were 5000 R, for β particles of $^{90}Sr/^{90}Y$ 8000 R. These doses were within the dose range therapeutically used. It was found that increasing dose fractionation and increasing intervals resulted in decreasing reactions to both kinds of radiation. Therefore, in very favorable cases, stronger reactions such as epitheliolyses and necrosis could be avoided. Comparing the reactions at the 25th and 50th day of the experiment showed that with a 48 hour interval during x irradiation there is still a distinct dependency upon the degree of fractionation. With β irradiation, this was found to be true for only the 25th day. Considering previous results, it can be concluded that with β irradiation the best results can be obtained with 5-fold fractionation and a 48 hour interval. (auth)

22746 ON THE QUESTION OF THE EFFECT MECHANISM IN THE X IRRADIATION OF ASCITES TUMORS OF MICE. Karrer, Karl (Oesterreichisches Krebsforschungsinstitut, Vienna); Regele, Heinz. Strahlentherapie, 129: 421-4(Mar. 1966). (In German).

A mouse ascites tumor was irradiated, prior to inoculation, with different doses of x rays at room temperature and at −80°C. When the results were compared, a distinctive radioprotective effect for the lower temperature was found. This effect is attributed to the diffusion inhibition of radicals and peroxides produced. From these results, both the direct and indirect effect of x irradiation on the total effect could be shown. (auth)

22747 EFFECT OF HIGH DOSES OF ^{60}Co GAMMA RAYS ON THE GLUTAMIC/GAMMA AMINOBUTYRIC ACID RATIO IN BRAIN TISSUE OF MICE. Jovanovic, Milan; Svecenski, Nadezda (Boris Kidrich Inst. of Nuclear Sciences, Belgrade). Strahlentherapie, 129: 446-7 (Mar. 1966).

In mice irradiated with lethal doses of γ radiation an elevated level of glutamic and aminobutyric acid was found in the brain tissue. The ratio of the specific activities of the two amino acids gave first lower and then higher values. (auth)

22748 INFLUENCE OF CONTINUOUS INTRAUTERINE IRRADIATION ON THE SEX RATIO AND THE BIRTH WEIGHT. Vorisek, Premysl (Anstalt fuer Muetter- und Kinderfuersorge, Prague). Strahlentherapie, 129: 448-55(Mar. 1966). (In German).

The litters of white rats (irradiated intrauterine and controls) were investigated in order to determine the sex ratio and the birth weight ratio of the newborns. The animals were irradiated daily with 2.5 R of ^{60}Co gamma rays continuously from the 1st to the 20th day of pregnancy. A total dose of 50 R was administered. The sex ratio was studied either at the end of the prenatal period or shortly after birth. For the evaluation of the birth weight, a homogenous animal material was chosen for the experiments, and the birth weight was studied as a function of the litter size. By means of regression analysis, it was found that there is no linear relationship between birth weight and litter size either in the control animals or in the experimental animals. An overall evaluation without considering the size of the litter and its variations is not sufficient. Continuous intrauterine administration of small doses of gamma rays caused no significant displacement of the sex ratio. This indicates that both sexes have the same radiation sensitivity during intrauterine development and that the course of sex differentiation is undisturbed. The mean birth weight of fetuses irradiated intrauterine was smaller than the one of the control animals. This difference was especially noticeable in litters with 9, 10, and 11 newborns. The difference is statistically significant in litters with 10 newborns. (auth)

22749 THROMBELASTOGRAPHIC INVESTIGATIONS ON PROFESSIONALLY RADIATION-EXPOSED PERSONS. Horst-Meyer, Horst zur (Humboldt Univ., Berlin). Strahlentherapie, 129: 456-9(Mar. 1966). (In German).

Thrombelastographic studies in persons who are occupationally exposed to x radiation show that disturbances in the hemocoagulation (prolonging of reaction and coagulation time) can be found in persons who have received a highly fractionated or protracted exposure with an average yearly total dose of about 0.4 rad. The differences in values between persons with radiation burden (≈0.4 rad/a) and persons with no radiation burden are distinct, since the age and sex ratio in both groups is the same. In the groups of persons with a higher burden (≈1.985 rad/a) and a higher average age a shortening of the reaction and contraction time should be expected. The extent of the disturbance is dose dependent. When chronic inflammatory processes are present at the same time, the thrombelastographic studies can be normal in spite of radiation exposure. A radiation induced disturbance in hemocoagulation can be normalized by avoiding further exposure to radiation. (auth)

22750 THE UTILIZATION OF X-RAYS IN EXPERIMENTAL INFRAMICROBIOLOGICAL INVESTIGATIONS. Sarateanu, D. Stud. Cercet. Inframicrobiol., 15: 473-90(1964).

The biological effects of x radiation on antibodies, animal cells, and viruses are reviewed. (116 references.) (C.H.)

22751 AN EVALUATION AND COMPARISON OF THE REGENERATION AND HEALING MECHANISM OF IRRADIATED HOMOGRAFTS, AUTOGRAFTS, AND HOMOGRAFTS IN AVIAN DIGITAL FLEXOR TENDONS. Ashley, Franklin L.; Marmor, Leonard; Polak, Teodor; Stone, Robert S. (Univ. of California, Los Angeles). Surg. Forum, 12: 477-9(1961).

Regeneration and healing mechanisms of tendon autografts, homografts, and irradiated homografts were compared with primary emphasis on the evaluation of the process of healing. Functional aspect of the grafts was considered secondarily. Chickens and turkeys were used, and the grafting procedures were carried out on the tendons of the musculus flexor digitorum profundus of the medial digit of the foot after excision of the flexor digitorum sublimus. Histochemical and biochemical examinations were made between the seventh and 56th days post-surgery. Tendon homografts were irradiated with 1.5 Mrad doses for purposes of sterilization and inflammation control. After irradiation, the tendons were stored in a freezer (–70°) for no longer than 3 months. Dense adhesions around the tendons were found, with good healing at the sites of the proximal and distal anastomoses. In chickens killed after mobilization, a separation of 0.5 to 2 mm was noted between the ends which had been filled by fibrous tissue. Tendon autografts survived in most cases and repair occurred at the sutured ends of the graft. All unirradiated tendon homografts were necrotic and fragmented, and later, no portion of the grafts was identifiable. (TCO)

22752 LETHAL FACTOR IN THORACIC DUCT LYMPH FOLLOWING SUPERIOR MESENTERIC ARTERY LIGATION. Tice, David A.; Dumont, Allan E. (New York Univ., N. Y.). Surg. Forum, 15: 86-8(1964).

Thorotrast-treated rabbits were used to demonstrate the presence of a toxin in the lymph of dogs submitted to superior mesenteric artery (SMA) ligation, a uniformly lethal lesion. Studies were performed on thoracic duct lymph collected after SMA ligation to determine whether lethal factors, if any, were present. It is concluded that factors present in lymph following SMA ligation are lethal for rabbits after reticuloendothelial blockade with Thorotrast. Gross and microscopic evidence concerning the nature of these toxins is not conclusive, but it is suggested they may be related to endotoxin and originate from the liver rather than the intestinal tract. (TCO)

22753 REDUCTION OF COLIFORM COUNTS IN THE SHUCKED BABY CLAM, VENERUPIS SEMIDECUSSATA, BY GAMMA IRRADIATION. Yamada, Kinjiro; Amano, Keishi (Regional Fisheries Research Lab., Tokyo). Tokaiku Suisan Kenkyusho Kenkyu Hokoku, No. 43, 91-6 (July 1965). (In Japanese).

The use of γ radiation to reduce bacterial contamination when given in the dose range between 50 and 1600 kR was examined on shucked V. semidecussata, a variety of sea clams abundantly harvested from culture beds in brackish waters in Japan. The keeping quality of the clams after irradiation was observed by subjective evaluation, together with some chemical and bacteriological examinations. By irradiation at 100 and 400 kR at 0°C, both the total number of bacteria and the most probable number (MPN) of coliform organisms in the product were considerably reduced. However, less diminution of these bacterial counts was noted at the same dose level when the clams were irradiated in the frozen state. No sign of spoilage was seen in the clams after four weeks' storage at 0 to 2°C; however, browning of the muscle portion and fading in the color of the foot occurred. The development of trimethylamine during storage was not evident, although an apparent increase in bacterial counts, including MPN of coliform organisms, was observed at the end of the storage period. With another lot of the same irradiated sample stored at –20°C, the clams retained a good condition, without showing any discoloration or appreciable bacterial growth. The use of γ irradiation at pasteurization dose levels is considered feasible for frozen clam products if the treatment is applied prior to freezing. (BBB)

22754 PROBLEM OF CARCINOGENESIS FOLLOWING PYELOGRAPHY WITH THOROTRAST. Alken, C. E.; Roucayrol, I. C.; Oberhausen, E.; Taupitz, A.; Ueberoberg, H. (Universitaetsklinik, Hamburg). Urol. Int., 10: 137-56(1960. (In German).

Two cases are described in which retrograde pyelography with Thorotrast was performed 23 yr previously. Renal deposition and retention resulted in development of an infiltrating carcinoma in the kidney pelvis in one patient and in extensive formation of hyaline connective tissue in the pelvic wall and perihilar tissues of the other. The highest concentration of ThO_2 was found in the carcinoma itself. In the first patient the carcinogenic dose was estimated to be 106,000 Rem, while the dose for the rest of the organ was approximately an order of magnitude less. The dose in the second patient was estimated to be the same, although no carcinoma had developed. It was not possible to ascertain whether the amounts of ThO_2 deposited had decreased over the years. The reason for this difference might have been differences in the localization of the ThO_2 and the tissue reaction to it. Usually the connective tissue within the immediate range of the α particles from ThO_2 reacts markedly. Since the range of the particles is probably ~80 μ in tissue, the relative concentration of collagenous tissue and tissue with only slight reaction to the irradiation is a very important factor in whether malignant changes might take place. (BBB)

22755 CROSS-REACTIVATION DIFFERENCES IN BACTERIOPHAGE T4D. Womack, Frances C. (Vanderbilt Univ., Nashville). Virology, 26: 758-61(Aug. 1965).

Cross-reactivation (marker-rescue) experiments, with bacteriophage T4D, showed that the genetic marker $tu42^+$ was slightly less sensitive to uv radiation than either $r48^+$ or $m42^+$. Also, tu45 is less sensitive to uv than the rII region of T4D. The rII region of T4 is presumably hypersensitive to uv, since the assumption that all regions of the genome are equally sensitive gives unreasonably low estimates of the total genome length from rII data. This report substantiates these observations: different markers differ in their probability of being rescued from a uv-irradiated genome, by as much as a factor of 8 at the same dose. Markers in the rII region have a low probability of being rescued. In addition to the segment containing the rII region, there exist at least two other segments of the T4D genome where cross reactivation occurs equally poorly. The experimental method used was essentially the rII method. Irradiated wild-type T4D which had received 51 lethal damages was used to infect Escherichia coli strain

CR-63 at a low multiplicity of 0.1–0.2. The bacteria were simultaneously infected with a higher multiplicity (not exceeding 3) of a nonirradiated carrier phage which contained one known mutation, and this mutation specified the marker to be cross-reactivated from the irradiated phage. The results suggest that the difference in ability of various markers to be rescued from uv-treated phage is an inherent property of the T4D genome. (BBB)

22756 GENETIC AND SOMATIC RADIATION EFFECTS, WITH SPECIAL CONSIDERATION OF RADIATION APPLICATIONS IN PREGNANCY. **Schinzel, A. (Univ., Innsbruck). Wien. Klin. Wochensch., 76: 601-4(Sept. 4, 1964). (In German).**

Experimental data on the hazards of mammalian irradiation during pregnancy are reviewed. It is pointed out that genetic effects of irradiation do not have any threshold value. In mice the lethal mutation rate in the sex chromosome was found to be approximately 2.4×10^{-7}R. Radioinduced lethality ceases at the onset of organogenesis, but developmental and structural anomalies may be induced. The most radiosensitive organ in the fetus is the eye, which in rats may be affected by as little as 25 R. The incidence of the most severe injuries of the eye and central nervous system is 100% if irradiation occurs during the first 2 months. It is 64% and 23%, respectively, for irradiation from the third to fifth and sixth to tenth month of pregnancy. Irradiation can also induce leukemia or other neoplasms if administered during any part of pregnancy, although the earlier periods show the greatest sensitivity. (TCO)

22757 ENCOUNTER WITH DISASTER—A MEDICAL DIARY OF HIROSHIMA, 1945. **Liebow, Averill A. (Yale Univ., New Haven). Yale J. Biol. Med., 38: 61-239(Oct. 1965).**

A diary is presented of the daily activities of the Joint Commission for the investigation of the Effects of the Atomic Bomb in Japan between September 18 and December 6, 1945. Preparation of the report of findings completed on September 7, 1946, is briefly discussed. (H.G.D.)

22758 STUDIES ON UV-INDUCED MUTATION IN SOME STREPTOMYCIN-DEPENDENT STRAINS OF PROTEUS MIRABILIS HAUSER. **Mates, Margot (Institut fuer Kulturpflanzenforschung, Gatersleben, Ger.). Z. Allg. Mikrobiol., 4: 22-41(1964). (In German).**

The radiosensitivity of several strains of Proteus mirabilis was studied. The survival curves of the strains fell sharply after exposure to uv irradiation. Streptomycin-sensitive strains were more radioresistant than the wild strains, and were markedly more radioresistant when cultivated in nutrient solutions that contained yeast extract. When irradiated with increasing amounts of single dose or fractionated uv during the logarithmic growth phase, there was no significant increase in revertants among streptomycin-sensitive strains. The number of revertants was not increased by addition of yeast extract, maltose, glucose, or casein hydrolysate and yeast extract seemed to decrease the number of revertants. The relation between irradiation dose and inhibition of cell division was quantized. Culture of bacteria for 3 to 45 hr in various highly concentrated nutrient solutions containing streptomycin before or after irradiation did not result in increased numbers of revertants. (TCO)

22759 LATE FINDINGS AFTER USE OF THOROTRAST: CLINICAL STUDIES. **Zastrow, Rosemarie; Roloff, Wolfgang (Universitaetsklinik, Rostock, Ger.). Z. Gesam. Inn. Med. Ihre Grenz., 20: 365-74(June 15, 1965). (In German).**

A survey was made between 1939 and 1951 of 160 patients who had been injected with Thorotrast for angiographic studies. By 1951 the records showed that 81 patients had died, 37 could not be traced, and 12 avoided examination. The remaining 30 cases were followed and examined at intervals. Nine additional cases were discovered in whom the contrast agent had been injected at an earlier period. Recent results of investigation of 21 patients are discussed. Significant findings besides bone marrow injury of slight or medium degree included detection of: an aplastic marrow syndrome, osteomyelosclerosis, several cases of osteosclerosis, hydronephrosis with hypertension as a result of a thorotrastoma, two painful thorotrastomas, cyst of the liver, cirrhosis of the liver, and several cases of fibrosis of the liver. (TCO)

22760 X-IRRADIATED MEDULLOBASTOMA AND ACUTE LEUKEMIA. **Gebert, Peter (Kinderklinik der Medizinischen Akademie, Dresden). Z. Kinderheilk., 93: 136-41(July 9, 1965). (In German).**

An 8-yr-old boy was treated surgically for medulloblastoma and irradiated postoperatively with a total focal dose of 6000 R administered over a period of 13 months. The irradiation administered was from a ^{60}Co source, and the initial focal dose amounted to 3000 R. The tumor recurred, but regressed when an additional 1900 R was given. A final dose of 1100 R did not produce tumor regression. The latency time between irradiation and development of leukemia was 13 months, which was rather short, compared to other reports. However, animal experiments have indicated that extended irradiation with small doses may lead to development of leukemia within a shorter latency period than a single irradiation with a large dose. Medulloblastomas have been shown to be associated with induction of leukemia in animals. (BBB)

22761 THE EFFECT OF SEXCOMBLESS IN GENETIC MOSAICS OF DROSOPHILA MELANOGASTER. **Mukherjee, Ardhendu S.; Stern, Curt (Univ. of California, Berkeley). Z. Vererbungsl., 96: 37-48(1965).**

Gynandric basitarsi possessing areas heterozygous for the sexlinked mutant sexcombless (sx) and hemizygous for it, and mosaic basitarsi possessing sx/+, sx/sx and +/+ areas were studied for the developmental expression of sx and sx/sx patches in the sex comb region. The mosaic basitarsi were obtained as the result of somatic crossing over following x ray exposure of larvae. In order to observe the sex comb-forming potencies in these XX tissues the flies had been made homozygous for the gene tra which transforms females into phenotypic males. The development of sx/+; tra/tra females is greatly prolonged over that of normal females. Five of the 63 gynandric and two of the 39 radiation-induced mosaics showed a single typical tooth, a sixth gynandric basitarsus had two teeth. In all other cases intermediate bristles, or macrochaetae, or both, have been found in y sn sx hemizygous or homozygous patches irrespective of their size. The sx-initiated distortion of bristle arrangement found in non-mosaic sx male basitarsi has also been seen in many mosaic patches. The mutant gene sx acts autonomously and interferes with the process of seta-cell to tooth determination at a relatively early stage in development of a bristle organ. (auth)

22762 ON THE AGGREGATE APPEARANCE OF TRISOMIC PLANTS IN THE PROGENY OF DIPLOID X-RAY MUTANTS OF OENOTHERA BERTERIANA. **Arnold, Carl-Gerold; Kressel, Maria (Univ., Erlangen, Ger.). Z. Vererbungsl., 96: 83-92(1965). (In German).**

In the progeny of radiation induced diploid X_1-variants of Oenothera berteriana, trisomic mutants were found quite frequently. The cause of this phenomenon is discussed. (C.H.)

22763 INVESTIGATIONS ON POLYHAPLOIDS FOLLOWING AUTOTETRAPLOIDS. II. THE SPONTANEOUS ORIGIN OF GENOME, CHROMOSOME, AND GENE MUTATIONS DURING THE TETRAPLOID STATE OF OENOTHERA HOOKERI DE V. **Linnert, Gertrud (Technische Univ., Berlin). Z. Vererbungsl., 96: 190-212(1965). (In German).**

Diploid offspring was induced in an artificial autotetraploid, Oenothera hookeri Freiburg, by pollinization with x rayed pollen. From its origin the tetraploid was propagated by selfing for 15 generations and in the last of these a panmictic population was produced to avoid loss of genes. Thirty-four tetraploid mothers yielded 454 diploid plants by the parthenogenetic development of unfertilized egg-cells. They were self-fertilized and a segregating progeny was grown from every plant. Two hundred and eighty-five diploids were also investigated cytologically. Chromosome patterns are described. (C.H.)

22764 ATTEMPTS AT CAUSING PLASMA MUTATIONS IN OENOTHERA. Arnold, Carl-Gerold; Kressel, Maria (Univ., Erlangen, Ger.). Z. Vererbungsl., 96: 213-16(1965). (In German).

Seeds, pollen, and vegetative parts of Oenothera berteriana were exposed to a number of radiation sources, including γ, x, and uv radiations, and β particles from ^{32}P and ^{35}S, in an attempt to cause plasma mutations. Results were not successful. (C.H.)

22765 HOST REACTIVATION OF EXTRACELLULAR RADIOINDUCED PREMUTATION IN SERRATIA PHAGE KAPPA. I. INCREASING THE MUTABILITY OF KAPPA BY HINDERING THE HOST REACTIVATION. Winkler, Ulrich (Johann-Wolfgang-Goethe Univ., Frankfurt am Main). Z. Vererbungsl., 97: 18-28(1965). (In German).

The frequency of c-mutations in phage Kappa induced by extracellular uv irradiation of the wildtype can be strongly increased by blocking the host cell reactivation (HCR) in its host Serratia HY. This is possible by using hcr-mutants of Serratia HY which are more or less unable to perform HCR, or by treating wildtype-cells during infection with caffeine or trypaflavine; both agents are known as poisons of the HCR-mechanism in E. coli. Revertants of the bacterial mutant strain hcr 42 to a phenotype similar to the wildtype are not homogeneous in their ability to reactivate lethal and mutagenic effects of uv on phage Kappa. This probably indicates that many of these revertants originated by suppressor-mutations. In all of them so far tested the ability to reactivate lethal and mutagenic effects was correlated in the same way. Kinetic studies with uv showed that the induction of c-premutations in Kappa follows a second-order reaction. Assuming that the two hits necessary for a premutation are host-reactivated in one act (and not separately) one finds about the same chance for the HCR of the lethal effects as for the premutations. HCR is not restricted to premutations induced by uv but also occurs if the premutations are induced by x rays. This does not necessarily mean that both types of premutations are chemically identical. (tr-auth)

22766 HOST REACTIVATION OF EXTRACELLULAR RADIOINDUCED PREMUTATION IN SERRATIA PHAGE KAPPA. II. ON PREMUTATIONS OF COMPLETELY QUENCHED BACTERIA MUTANTS. Winkler, Ulrich (Johann-Wolfgang-Goethe Univ., Frankfurt am Main). Z. Vererbungsl., 97: 29-39(1965). (In German).

The frequency of c-mutants among the survivors of extracellularly uv irradiated phage Kappa increases with the uv dose if the phages are plated on untreated wildtype-cells (hcr^+) of Serratia HY. After adsorption of the same phages to the mutant strain hcr91 (or hcr614) the frequency of c-mutants is not enhanced by uv irradiations. This effect of hcr91 can be explained by assuming that in this strain there exists a light-independent mechanism which reactivates every premutation in the phage DNA. Reactivition occurs also in the wildtype of Serratia HY, however it effects only about 95% of the premutations. The single step mutation from hcr^+ to hcr91 causes not only an increase of the ability to reactivate premutations but also a decrease in the ability to reactivate lethal lesions in Kappa. This suggests that during the mutation from hcr^+ to hcr91 the dark-reactivating mechanism of Serratia HY changed its specificity to its two substrates. the premutations and the lethal lesions, in opposite direction. The premutation reactivating mechanism of hcr91 is not restricted to lesions produced by uv but affects also those induced by x rays or hydroxylamin. This suggests that the agent responsible for the reactivation works directly or indirectly on more than a single type of base-change in the phage-DNA. The frequency of c-mutants among the survivors of uv irradiated Kappa is significantly higher on uv preirradiated hcr91 than on untreated control-cells. It may be concluded from this that in preirradiated hcr91 the reactivation of premutations in the phage-DNA is competitively inhibited by photochemically similar premutations in the host-DNA. Furthermore, it suggests that the reactivating agent in hcr91 is presumably an enzyme. (tr-auth)

22767 ON THE PHOTOREACTIVATION OF LETHAL INJURIES AND PREMUTATIONS IN EXTRACELLULAR UV IRRADIATED SERRATIA PHAGE KAPPA. Winkler, Ulrich (Johann-Wolfgang-Goethe Univ., Frankfurt am Main). Z. Vererbungsl., 97: 75-8(1965). (In German).

In phage Kappa which has been irradiated extracellularly with different uv doses about 75% of the lethal damage can be nullified by adsorption to stationary wildtype-cells of Serratia HY and maximum photoreactivation. Assuming that the two hits necessary for a uv induced c-premutation are photoreactivated at once the photoreactivable sector among the premutations is about 71%; this would mean that the photoreactivating enzyme in Serratia HY can not distinguish between premutations and lethal lesions. However, if these two hits are photoreactivated separately the photoreactivable sector would be only 45%. At present one can not decide between these two possibilities. (tr-auth)

22768 DARK AND K REACTIVATION IN UV-IRRADIATED ESCHERICHIA COLI. Kneser, H. (Univ., Cologne). Z. Vererbungsl., 97: 102-10(1965).

The effect of uv on the survival of E. coli strains with different sensitivities was measured under several post-irradiation conditions which have been found to influence only the efficiency of two known reactivation mechanisms. Strains BB, B, and Bs-1 (equivalent to fil^+ and probably lon^-) cannot use a reactivation mechanism which is active in K12 (K-reactivation). Only a regulatory component is lacking, which can be substituted for by pantoyl lactone or heat treatment. B or BB cells in the growing state perform incomplete dark-reactivation; liquid holding or growth to the stationary phase restore it. K-reactivation also allows completion of dark reactivation. (auth)

22769 PHOTOREVERSION AND PHOTOPROTECTION OF UV-INDUCED MUTATIONS OF NONPHOTOREACTIVABLE E. COLI BACTERIA PHR^-. Kaplan, R. W.; Witt, Gerda. Z. Vererbungsl., 97: 209-17(1965). (In German).

Stationary phase cells of strain phr^-/MC2 of E. coli are not photoreactivable but the frequency of uv induced mutations to low streptomycin-resistance is decreased strongly by illumination with light of fluorescence tubes (310 to 500 nm) after uv irradiation. Also dark-reversion (DRM) of these mutations due to keeping uv irradiated cells in saline is observed. Illumination before uv irradiation decreases the frequency of the mutations (photoprotection against mutation = PPM) to the same extent as the combined action of photoreversion (PRM) and DRM. The lag-phase of cell division is prolonged strongly by illumination from 80 min without light to 150 min by the light dose of highest activity. The additional lag is nearly the same if the illumination is done before, after or without uv irradiation; this lag is about additive to the small lag caused by uv. Pre-illumination of the stationary-phase cells does not cause photoprotection against killing (PP), it even decreases the survival after high uv doses. The observations support the hypothesis that PRM in this strain may be indirect, i.e., caused by the light-induced additional division lag which enhances the dark repair of uv premutations. Also spontaneous premutations which are apparently present in the stationary-phase cells seem to be influenced by the light in this way. (auth)

22770 INCREASING THE TRANSLOCATION RATE IN TRISOMIC MUTANTS OF OENOTHERA BERTERIANA. Arnold, Carl-Gerold; Kressel, Maria (Univ., Erlangen, Ger.). Z. Vererbungsl., 97: 255-71(1965). (In German).

Among the progeny of diploid x ray induced mutants of Oenothera berteriana trisomic plants appear in a higher frequency than usual. Cytological observations of these trisomic mutants demonstrated that in diakinesis there are very often arrangements of chromosomes which led to the conclusion that translocations had taken place. The cause of this phenomenon is discussed. (C.H.)

22771 ESTUDO RADIOBIOLOGICO DO SISTEMA LISOGENICO DO STAPHYLOCOCCUS ALBUS. ASPECTOS DA REPLICACAO VIRAL; EFEITOS DA ESTREPTOMICINA. (Radiobiological Studies of Lysogenic Staphylococcus Albus. Effects of Streptomycin). Caldas, Luiz Renato. Rio de Janeiro, Universidade do Brasil, 1963. 56p.

Lysogenicity was studied in uv- or x-irradiated Staphylococcus alba to determine: the survival curve of P(w) and W5 sr phages; the induction curve of P(w) phage; the

induction of P(w) by small doses of uv; and the latent period of P(w). Radioinduced bacterial inactivation was shown not to result from the interaction of a single photon. Latency for phage P(w) was 45 min for x rays and 50 min in the case of uv-irradiation. Analysis of the ascending portion of the P(w) induction curve suggested that inactivation is due to a dual mechanism; two photons interact either with a single volume or with two separate volumes. Relative biological effectiveness of x rays was approximately 600 times greater than that of uv in inactivating bacteriophages. Results indicate that S. alba would serve as a biological dosimeter. The effects of streptomycin on viral replication in lysogenic systems were also studied. (H.G.D.)

22772 L'OEIL ET LES RADIATIONS IONISANTES. TOME PREMIER AND SECOND. (The Eye and Ionizing Radiations. Vol. I and II). Haye, C.; Jammet, H.; Dollfus, M.-A. Paris, Masson and Cie, Editeurs, 1965. 1444p. 200 F.

Radiation effects on eyes from exposure to medical, industrial, or military sources of ionizing radiation are considered. Eye injuries resulting from the Hiroshima and Nagasaki explosions, from experimental explosions, and from laboratory accidents are discussed. Secondary ocular lesions induced by gamma or x rays were studied with particular emphasis on the genesis of cataracts. Radiodiagnosis and radiotherapy of ocular tumors are considered, and basic principles of radiation biology are reviewed. (H.G.D.)

Radiation Effects Therapy and Countermeasures

22773 (AD-621079) ELECTROCHEMICAL STUDIES OF ANTIRADIATION DRUGS. RADIATION EFFECT ON PROTEINS IN THE ABSENCE AND PRESENCE OF THESE DRUGS. Annual Report No. 4(Final). Report No. 241. Stricks, Walter (Marquette Univ., Milwaukee, Wis. Dept. of Chemistry). Sept. 17, 1965. Contract DA49-193-MD2146. 112p. CFSTI $4.00 cy, $0.75 mn.

Results are reported from polarographic and other electrochemical studies of radiation protective agents containing sulfhydryl, disulfide and thiosulfonate groups. These studies were applied to the quantitative determination of sulfhydryl and disulfide compounds by argentimetric and mercurimetric amperometric titration. Using these methods, it is possible to determine the sulfhydryl groups formed in bovine plasma albumin solutions after exposure to ultraviolet light. The formation of sulfhydryl groups is explained by the rupture of disulfide during irradiation, one disulfide group giving rise to one sulfhydryl group. Also the polarographic catalytic effect of radiation protective drugs and of plasma albumin solution after irradiation in the absence and presence of these drugs was studied. The splitting of disulfide upon irradiation is accompanied by changes of the viscosity, optical rotation, and light absorption in the ultraviolet region. The relationship between changes of these properties and the number of broken disulfide groups was demonstrated. (auth)

22774 CLOSURE OF SKIN DEFECTS IN AN IRRADIATED AREA BY THE KERCHIEF FLAP METHOD. Grignon, J. L.; Andrieu, J. (Hopital Saint-Antoine, Paris). Ann. Oto-Laryngol., 81: 761-70(Dec. 1964). (In French).

The problems and causes of failure to obtain closure of radioinduced skin defects are reviewed. Results of using the kerchief flap method for pharyngostomies, destruction of the lateral bucco-pharyngeal tissue, the ethmoidal-maxillary tissue, and nasal tissues are reported. Variables analyzed are: characteristics of irradiated tissue; chances of infection; and characterization of the repair area. (TCO)

22775 SULFURATED MINERAL WATER AND METHYL BIS(β-CHLOROETHYL)AMINE. Di Carlo, R.; Pagnini, G. (Univ., Naples). Boll. Soc. Ital. Biol. Sper., 39: 1363-5 (1963). (In Italian)

Sulfurated mineral water from an Italian spa given to mice ad libitum 10 to 75 days before exposure to 700 R, single-dose irradiation caused a significant reduction in mortality. Experiments were performed to compare the protective effect of this water in mice given a radiomimetic agent, methyl bis(β-chloroethyl)amine or mechlorethamine. Swiss mice of the Moroni strain were given either Naples city water or sulfurated mineral water (Vanacore di Castellammare) for 30 days, after which time they were injected intraperitoneally with 2.5 or 5 mg/kg mechlorethamine. The higher dose killed all mice by the 5th day, whereas after the lower dose of the drug, about 20% of the mice survived for 20 days or longer. No significant differences in the percent mortality-time curves in mineral water as compared with city water-treated mice were seen. These results differed from those with 700 R doses of x rays indicating a basic difference in the action of ionizing radiation and this radiomimetic agent. This agent acts directly on nucleic acid metabolism, whereas ionizing radiation probably acts indirectly. (BBB)

22776 QUANTITATIVE EVALUATION OF THE RADIOSENSITIVITY OF CELLS OF A TRANSPLANTABLE RHABDOMYOSARCOMA IN THE RAT. Reinhold, H. S. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Europe. J. Cancer, 2: 33-42(Feb. 1966).

Using an improved cell dispersion technique, survival curves were obtained for x irradiated cells of a transplantable solid rat tumor (rhabdomyosarcoma). Variable doses of irradiated or non-irradiated tumor cells were inoculated into isologous recipients. The non-irradiated (control) ED_{50} calculated according to the method of Litchfield and Wilcoxon varied from 32 cells to 13.5 cells for the different experiments. The results show that the D_{37} of the anoxic cell survival curve (irradiation in the dead animal with doses from 480 to 3840 rad) is about 380 rad, the extrapolation number N is approximately 10. An oxygen enhancement ratio of 3 was found. Comparison of these figures with results obtained by others with a murine leukemia suggests that the D_{37} of the survival curves for cells from radiosensitive and radioresistant tumors are similar, the extrapolation number probably being different. By delivering doses between 480 to 3840 rad to small tumors with an average weight of 0.4 g (containing 2×10^8 cells) in the living non-anaesthetized animals, the survival curve of the in vivo tumor was estimated. From the shape of the various curves it was deduced that 15% of the cells of these small tumors has probably been in an anoxic state at the time of irradiation. This proportion of anoxic cells, together with a rather high extrapolation number, provide a satisfactory explanation for the radioresistance of this type of tumor. (tr-auth)

22777 INFLUENCE OF ADENOSINE TRIPHOSPHATE ON RADIATION PNEUMONITIS. Hartweg, H.; Lemanczyk, D. (Univ., Basel). Experientia, 22: 147-8(1966). (In German).

The radioprotective effects of ATP were studied in white rats exposed to single 2000 R doses of ^{60}Co γ rays. Histological studies were made on lungs of animals sacrificed 45 days post-irradiation. In the control group, 3 animals survived 4 days post irradiation. Animals exposed to ATP prior to irradiation survived 38 to 41 days. The administration of ATP in a dosage sufficient to decrease mortality to a significant degree did not decrease the incidence of radiation pneumonitis. It is concluded that the action of ATP depends more on its action upon protein metabolism than on morphological cell structures. (H.G.D.)

22778 POSSIBILITIES AND LIMITATIONS OF ANTIBIOTIC THERAPY IN RADIATION-INJURED TISSUE. Schuele, Helmut (Univ., Kiel). Fortschr. Kiefer-Gesichtschir., 8: 91-9(1962). (In German).

The various types of radiation injury that may occur after irradiation of facial and oral tissues are described, with emphasis on bone lesions. The prevention and treatment, particularly with antibiotics and surgery, of such lesions are also described. Experiments were conducted in rabbits to determine the blood-tissue distribution of antibiotics after whole-body irradiation with and without

staphylococcal infections. It is pointed out that antibiotics assist surgical intervention in the treatment of radioinduced osteomyelitis but cannot replace it. Antibiotic doses are recommended for use in preventing infection in radioinjured tissues. (TCO)

22779 PARTIAL DECREASE OF RADIATION DAMAGE AND THE MUTATION PROCESS IN GRAIN CROPS. El'shuni, K. A.; Khvostova, V. V.; Stoletov, V. N. (Inst. of Biological Physics, Moscow). Genetika, No. 3, 70-4 (Sept. 1965). (In Russian).

Experiments carried out on seeds of spring barley var. Viner, spring wheat var. Lutescence-62 and wheat-rye amphidiploid 25AD20 showed that additional treatment at the time of γ-irradiation led to the reduction of a considerable part of radiation damage, which was clearly manifested by a decrease in the percentage of chromosome aberrations in seedling root cells. However, the number of M_2 mutations has not decreased after additional treatment and in some cases it appeared to be even higher. In cases of irradiation by fast neutrons (average energy 1 to 2 Mev) additional treatment failed to exert any influence. (auth)

22780 INFLUENCE OF ARGININE ON RADIATION DAMAGE OF SPERMATIDS AND SPERMATOCYTES IN DROSOPHILA. Abeleva, E. A. (Inst. of Biological Physics, Moscow). Genetika, No. 6, 115-19 (Dec. 1965). (In Russian).

The effects of arginine on spermatogenesis were investigated in γ-irradiated (1000 or 1500 R) Drosophila melanogaster males. The crossing-over frequency was determined in the F_1 progeny of irradiated males crossed with virgin females. Neither the time nor the frequency of crossing-over were affected by arginine. Comparison of fertility curves of males both exposed and unexposed to arginine treatment suggested that arginine either removes or reduces the radioinduced delay of spermatogenesis. Protective actions of arginine were further shown to be very versatile. (H.G.D.)

22781 SOME TOPICAL DRUGS CURRENTLY USED IN DERMATOLOGIC THERAPY AND ULTRAVIOLET RADIATION. Bravi, G.; Levi, L. (Univ., Milan). Giorn. Ital. Dermatol., 105: 697-710 (Nov.-Dec. 1964). (In Italian).

Fifty human subjects were treated topically with many preparations, some of which were considered to have a radiosensitizing action, prior to uv-irradiation of the skin. The agents tested included 1% aqueous methylene blue, Ziehl's fluid (fuchsin), 1% aqueous gentian violet, tincture of iodine (1% in alcohol), and coaltar. The degree of erythema developing in skin with and without local application of the agents was measured. Even though these substances absorb radiation in the range used, their effect was in most instances a protective rather than a photosensitizing one, the degree of erythema being less in treated areas. Often the intensity of pigmentation and desquamation was also less in the dye-treated skin. Ziehl's fluid caused pigmentation to develop earlier after uv irradiation than in control skin. The screening effect of these agents on some wavelengths of uv light is discussed. (BBB)

22782 OBSERVATIONS ON THE RADIOPROTECTIVE EFFECT OF A HETEROLOGOUS SPLEEN EXTRACT IN RATS. STUDIES MADE WITH THE AID OF ^{59}Fe. Cultrera, G.; Magliulo, E.; Zanolla, W. R.; Slaviero, E. (Univ., Pavia, Italy). Haematologica, 49: 1-10 (1964). (In Italian).

An evaluation of the effectiveness of spleen homogenates to restore hematopoiesis (mainly erythropoiesis) was studied with the aid of ^{59}Fe in irradiated rats. The adult rats were injected with 1 μC of ^{59}Fe (as the citrate) and x irradiated with 400 R. At one-half hour after irradiation and daily thereafter, for two weeks, the rats were injected intramuscularly with 5 g of lyophilized calf spleen. Measurements of red blood cell radioactivity indicated that control (nonirradiated) rats utilized ~50% of the injected ^{59}Fe, compared to only ~25% in the irradiated rats not injected with spleen homogenate. In the irradiated rats injected with the spleen preparation, a sharp rise in ^{59}Fe incorporation in erythrocytes occurred about the 7th to 9th postirradiation day until ~65% of injected radioactivity was incorporated in erythrocytes by the 15th day. Radioassays of bone marrow showed a ^{59}Fe content in irradiated-injected rats intermediate between that of controls and irradiated-uninjected rats. Uptake of radioactivity by spleen and liver was highest in controls, lowest in irradiated-injected rats, and intermediated in irradiated-uninjected rats. The results indicate that spleen homogenate exerts a stimulatory effect on erythropoiesis in sublethally irradiated rats. (TCO)

22783 PHOTOREACTIVATION OF ULTRAVIOLET INDUCED RECIPROCAL RECOMBINATION, GENE CONVERSION AND MUTATION TO PHOTOTROPHY IN SACCHAROMYCES CEREVISIAE. Parry, James M.; Cox, B. S. (Univ. of Liverpool). J. Gen. Microbiol., 40: 235-41 (Aug. 1965).

Yeast strains heteroallelic for the adenine-2 locus, heterozygous for outside markers, and homozygous for tryptophan-1 were uv irradiated and the effect of post-treatment with white light determined. Mitotic gene conversion to adenine independence and mutation to tryptophan independence and adenine independence were both decreased by post-irradiation treatment with white light, whereas mitotic reciprocal recombination of outside markers was unaffected. The effect of varying the treatment with white light after a constant degree of exposure to uv radiation produced a decrease in reversion frequency to a constant value at light exposures of 5 min and more. The decrease in reversion to prototrophy was accompanied by an increase in survival. This contrasts with the absence of any effect of post-treatment on reciprocal recombination, where the same frequency of recombinants was obtained with and without post-treatment with white light. This difference in response between reciprocal recombination and gene conversion was also observed earlier in a diploid yeast heterozygous for adenine requirement (AD/ad) and heteroallelic for the gene controlling melezitose fermentation (MZ), and it was conversion concluded from the earlier results that reciprocal recombination and gene conversion were interdependent. However, the present results indicate that the processes are distinguishable by their response to photoreactivation by white light. Possible explanations are discussed. (TCO)

22784 PROTECTION OF MICE AGAINST ACUTE INJURY OF X-IRRADIATION AND ADMINISTRATION OF RADIOMIMETICA BY TRANSPLANTATION OF HOMOLOGOUS OR HETEROLOGOUS TISSUES. Tsai, Po Yen (Kyoto Univ.). Kyoto-Furitsu Ika Daigaku Zasshi, 72: 299-320 (1963). (In Japanese).

Various homologous and heterologous tissues (bone marrow, spleen, liver, adrenal glands, and kidney) from guinea pigs were transplanted subcutaneously on the backs of strain N-1 mice of both sexes approximately 5–6 weeks old, weighing 11–13 g. Prior to the transplants, the mice had been subjected to whole-body irradiation doses of 650 R with 170 kv x rays. The mice were then treated with intraperitoneal injection of 1.0 mg of Nitromin/10g body weight or oral administration of 0.15 mg of TEM/10 g of body weight, and their effect was investigated by 28 day survival percentage body weight changes and histopathological study on the bone marrow as criteria for evaluation. For the protection from acute injury induced by a single whole-body large x-irradiation, homo- and heterologous bone marrow was most effective; homologous spleen exhibited almost similar effects; homologous liver was somewhat inferior; and homologous adrenal gland and kidney and heterologous tissue with the exception of the bone marrow showed no protective effect. For protection from acute injury caused by the intraperitoneal injection of Nitromin, the protective effect of the various homo- and heterologous tissues was qualitatively the same but quantitatively not so remarkable, as for the x-irradiation. For the protection of the acute injury due to oral administration of TEM, the experimental results were somewhat unstable; however, the homo- and heterologous bone marrow appeared to have some slight protective effect, with the effect of homologous spleen and liver barely observable. (TCO)

22785 RADIOSENSITIZERS AND METHODS OF INCREASING THE RADIOSENSITIVITY. Tubiana, M.; Frindel, E. Med. Radiol., 10: 55-67(Aug. 1965). (In Russian).

Experiments were run to see whether or not the effectiveness of repeated irradiations could be increased by selecting the proper interval of time between two successive irradiations. Mice were given a 150 R x ray dose, and were injected with 5 μC of ^{3}H-thymidine. At various periods of time after the irradiation, the specific activity of the bone marrow was determined by scintillation counting. The same type of experiment was run on mice having transplanted tumors, from which the DNA was extracted and counted. The results showed that the changes in specific activity with time were associated with a change in the number of cells in the DNA synthesis phase, and not with a change in synthesis rate. This effect was masked somewhat by the elimination of inactive cells. This method deserves further development because of its prospective use in radiotherapy. (TTT)

22786 EFFECT OF ASSOCIATED RADIOPROTECTIVE DRUGS (CYSTEAMINE, SEROTONIN, AET) ON THE SURVIVAL OF ANIMALS IRRADIATED WITH MEAN LETHAL AND TOTAL LETHAL DOSES OF X RAYS. Arghittu, C.; De Renzi, G.; De Pascalis, V.; Bragazzi, G. (Centro Nucleare S. Pietro a Grado, Pisa, Italy). Minerva Nucl., 9: 376-8(Nov.-Dec. 1965). (In Italian).

It has recently been stated that radioprotection with mixtures of radioprotective drugs is much more effective than radioprotection with each substance given singly. The action of mixtures of cysteamine, serotonin, and AET was investigated in rats irradiated with semi-lethal and totally lethal doses of x radiation. Two experiments were done in male Wistar rats weighing 250 g. In the first experiments, the rats were inoculated one hour before irradiation with the radioprotective agents and were irradiated with a 55/30 LD; in the second experiment, the rats were treated as before and irradiated with a 100/30 LD. Ninety-five % of the rats irradiated with a 55/30 LD survived and 30% of the rats irradiated with a 100/30 LD survived. (auth)

22787 EFFECT OF VARIOUS CELL-DISPERSING METHODS ON ABILITY OF MOUSE FETAL LIVER TO PROTECT IRRADIATED MICE. I. CULTURED FETAL LIVER. Hammond, Carolyn W.; Byrne, Anne F. (Univ. of Illinois, Chicago). Proc. Soc. Exp. Biol. Med., 121: 958-61(Mar. 1966).

Cells from mouse fetal liver were dispersed by means of trypsin, pancreatin, oxoid pancreatin, elastase, trypsin plus methocel or pancreatin plus methocel. Dispersed cells were grown in tissue culture for 4 to 13 days and monolayers harvested with the same enzyme used for dispersion of cells from fresh tissue. Cultured cells were injected intravenously into lethally irradiated mice. Cells dispersed with trypsin and methocel and grown for 7 days protected 22% of lethally irradiated mice. Mean survival time of treated mice was 8 days longer than controls. Cultured cells dispersed with other enzymes did not protect irradiated mice nor was their survival time prolonged. It is concluded that the multipotential cell responsible for seeding bone marrow is extremely sensitive to manipulation. (auth)

22788 EFFECTS OF RADIOPROTECTORS AGAINST FRACTIONATED DOSES OF RADIATION. 2. PROTECTIVE EFFECTS AGAINST VARIOUS DOSES AND TIME INTERVALS BETWEEN THE EXPOSURES. Yarmonenko, S. P.; Ovakimov, V. G.; Ol'shevskaya, O. P.; Lavrenchik, E. I. (Inst. of Industrial Hygiene and Occupational Diseases, Moscow). Radiobiologiya, 5: 899-906(1965). (In Russian).

During the injection of AET in mice subjected to a single whole-body irradiation or fractionated doses, regardless of the dose or radiation (in the range from 270 to 700 R), the given number of cells of the bone marrow was constant. The ratio of the protected cells to the total number of retained elements of bone marrow decreases with the reduction of the dose, inducing a reduction of the protection coefficient. For fractionated doses, the protective effect of the reagent increases with the prolongation of the interval between the individual irradiations, which in turn is connected with the degree of restoration of hematopoiesis. The protective effect of the reagents during fractionated and individual exposures in the final calculation leads to the decrease of the effective radiation dose and is connected with the acceleration of the restoration because of the large number of remaining hematopoietic cells in the protected animals in comparison with the controls. The combined use under conditions of fractionated irradiation of the complex of cystaphos + 5-MOT leads to an increase of the protective effect both in sublethal and supralethal single doses that is greater than in the individual use of the protective reagents. (tr-auth)

22789 CHIMERIC MICE WITH DONOR-TYPE LIVER CELLS. Hard, Richard C. Jr. (Univ. of Minnesota, Minneapolis); Kullgren, Birgitta. Science, 152: 349-52(Apr. 15, 1966).

C_3H mice, made chimeric by lethal x-irradiation followed by injection of $(C_3H \times T_6)F_1$ spleen cells, were later stimulated by CCl_4 to produce a vigorous burst of hepatic parenchymal cell mitoses. Cytogenetic studies of the regenerating livers of 11 chimeras identified 89% of the cells as donor type by the presence of the distinctive T_6 marker. (auth)

22790 RADIOSENSITIZATION OF X CHROMOSOME OF CHINESE HAMSTER CELLS RELATED TO INCORPORATION OF 5-BROMODEOXYURIDINE. Dewey, W. C.; Sedita, B. A.; Humphrey, R. M. (Anderson (M. D.) Hospital and Tumor Inst., Univ. of Texas, Houston). Science, 152: 519-21(Apr. 22, 1966).

Selective incorporation of 5-bromodeoxyuridine into the late replicating arm of the X chromosome of Chinese hamster cells cultured in vitro caused a selective radiosensitization of the arm to ionizing radiation. Radiation damage was observed as chromosomal aberrations, and incorporation was studied by using tritiated 5-bromodeoxyuridine. (auth)

22791 INVESTIGATIONS ON A BIOLOGICAL RADIATION PROTECTION. PART 68. RADIATION SENSITIVITY AND PROTECTIVE EFFECTS OF SEROTONIN ON MICE OF DIFFERENT AGE STEPS. Langendorff, Hanns; Langendorff, Margarethe (Univ., Freiburg i. B. Heiligenberg Inst., Ger.). Strahlentherapie, 129: 425-31(Mar. 1966). (In German).

One to 70 day old mice were x irradiated with 300, 400, 500, or 600 R during different stages of age. It was shown that mice are especially sensitive to radiation between the 28th and 35th day of life. Beyond that, the radiation resistance of the animals showed a steep increase up to the 50th day of life. Administration of 5-hydroxytryptamine (serotonin) resulted in a protective effect in all animals which were irradiated with 600 R. The smallest protective effect was observed in one day old animals. (auth)

22792 RADIATION SENSITIVITY OF IRRADIATED RATS IN HYPOXIA. Hornung, Guenter; Braun, Heribert; Krackhardt, Hermann (Medizinische Universitaetsklinik, Wuerzburg, Ger.). Strahlentherapie, 129: 432-7 (Mar. 1966). (In German).

The influence of hypoxia on the survival time of total-body x irradiation rats was investigated. The animals were in a condition of hypoxia before or during irradiation. The inhalation of a defined mixture of oxygen deficiency (partial oxygen pressure of 100 mm Hg) caused a distinct hypoxia within a short period of time. An increase of radiation tolerance was found when animals were kept in hypoxia during irradiation that resulted in a prolonged survival time. (auth)

22793 THE INFLUENCING OF X-RADIATION EFFECTS BY VARIOUS SUBSTANCES (VICIA FABA AND GUINEA PIG INVESTIGATIONS). Maggiora, Armando; Lozeron, Henri; Jadassohn, Werner (Dermatologische Universitaetsklinik, Geneva). Strahlentherapie, 129: 438-45(Mar. 1966). (In German).

Using the Vicia-faba-test it could be observed, that serotonin has a small but significant protective effect against x rays when used immediately after irradiation. Indol-acetic acid (heterauxin) as well as 2,4,5-trichloro-

phenoxy-acetic acid had a distinct sensitizing effect as shown by the Vicia-faba-test. Using the Vicia-faba-test as well as the guinea pig flank, it was shown that tanderil sensitizes against x rays. Butazolidine which has, compared to tanderil, no OH-group, showed a slightly protective effect in the Vicia-faba-test; while G.P. 27,463, which has 2 OH-groups, showed the same sensitizing effect as tanderil. (auth)

Radiation Hazards and Protection

See also HEALTH AND SAFETY

22794 (EUR-2769.f) EFFETS AIGUS ET CHRONIQUES DES RADIATIONS ENVISAGEES SURTOUT AU POINT DE VUE DU METABOLISME DES ACIDES NUCLEIQUES ET DES PROTEINES. Rapport Final. (Acute and Chronic Effects of Radiations Considered Primarily from the Point of View of Nucleic Acid and Protein Metabolism). Final Report. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Jan. 17, 1966. 34p. Dep. mn.

Progress is reported on studies on the early cytochemical and biochemical effects and on the genetic effects of ionizing radiations on plants and mammalian tissues and on their modifications by radioprotectors. Emphasis was placed on studies on the effects of x radiation on the metabolism of nucleic acids and proteins and studies on the mechanisms of action of chemical radioprotectors; the increased effectiveness of mixtures of radioprotectors; the study of the influence of radioprotectors on cell metabolism; and studies on the influence on the permeability of the cell membrane to DNA and on the translocation of DNA in different organisms (mice and plants), by means of chromatographic studies with DEAE-cellulose paper, ultracentrifugational studies in CsCl gradients, and autoradiographic studies. A list is included of 73 publications that report the findings in detail. (C.H.)

22795 ^{137}Cs IN THE HUMAN BODY. Moiseev, A. A. Gig. Sanit., No. 1, 82-8(Jan. 1966). (In Russian).

^{137}Cs enters the human body from the biosphere through the food chain. Reaching the surface of the soil from the fallout, it is assimilated to a much lesser extent by the plants than ^{90}Sr; only 3 to 4.5% of the available total reaches the human body. Studies carried out in the United States and Canada indicated that in those countries about 60% of ^{137}Cs enters the body with milk products and 25 to 35% with meat; in Japan, one half of this isotope reaches the body with cereal, the other half with milk, meat products, and vegetables. In view of its biological half-life, the tissue dose from incorporated ^{137}Cs may be neglected for practical calculations; an equilibrium is rapidly established between the concentrations in the foodstuffs and the body, preventing further accumulation. Data on the body burden of persons living in the Northern Hemisphere agreed well with each other, although higher values were obtained in certain areas, such as Alaska, Northern Canada, and Scandinavia. The United Nations Scientific Commission on Radiation Effects indicated that for concentrations of 10^{-12}C/g of ^{137}Cs, the tissue dose is 10 mrem/year. (Review article) (TTT)

22796 RATIO OF ABSORBED DOSES AND THE SPECTRAL COMPOSITION OF β AND γ RADIATIONS IN A RADIOCHEMICAL LABORATORY. Zeinalov, E. I.; Obaturov, G. M.; Chumbarov, Yu. K. Gig. Sanit., 2: 43-6(Feb. 1966). (In Russian).

Investigation of the part of β particles in the total dose of β and γ radiations in a radiochemical laboratory showed that the average ratio of the dose of β and γ radiations for the skin and the crystalline lens of the laboratory workers amounts to 2.5 and 0.5, respectively, during work with radioactive solutions and products and equals 5 and 1.3, respectively, during work in contaminated premises (hot chambers, repair area, etc.). The crystalline lens proved to be the critical organ. The most effective measure for protection against β radiations is the use of protective goggles or a visor, that practically exclude irradiation of the crystalline lens with β particles. (auth)

22797 BONE MARROW INJECTION EFFECTS ON HISTOCHEMICAL METABOLISM IN SPLEEN IN IRRADIATED MICE. Ogandzhanyan, E. E. Izv. Akad. Nauk Arm. SSR, Biol. Nauki, 18: No. 12, 57-66(Dec. 1965). (In Russian).

In the spleen of x irradiated mice substantial changes occur in the intensity of the metabolism. In the fibrous structure of the vessel wall and stroma of the spleen an increase of the quantity of α-amino acid was observed which reached a maximum 8 hrs after radiation exposure. In the subsequent days an insignificant decrease of the concentration of the α-amino acid occurred. In the first post-radiation day a gradual but steady increase of the level of muco- and glycoproteins occurred in the vessel wall and the connective tissue of the stroma. The period of decrease of the concentration of the muco- and glycoproteins coincided with the period of increase of inorganic iron in the spleen. It is possible that the continuous increase of the disturbance of exchange processes (exchange of albumin and of muco- and glycoproteins) in the vessel wall and stroma indicates a decrease of their permeability and is one of the factors that is instrumental in the accumulation of inorganic iron in the organ. Intrasplenic injection of bone marrow showed beneficial effects on the pattern of the histochemical changes in the spleen. In particular, the injection of bone marrow, specifically in conjunction with prophylactic administration of estrogen, promoted a very early normalization of the exchange of muco- and glycoproteins and inorganic iron. An increase of the quantity of α-amino acid occurred during the injection of bone marrow. (tr-auth)

22798 ESTIMATION OF BONE MARROW DOSE FROM PHOTOFLUOROGRAPHY IN JAPAN. Hashizume, Tadashi (National Inst. Radiology Sciences, Chiba, Japan); Suzuki, Shiego. Nippon Acta Radiol., 25: 991-7(Nov. 1965). (In Japanese).

As a part of the program to estimate the national radiation dose of the Japanese people, an estimation was made of the bone marrow absorbed dose from photofluorography per year per person in Japan. To determine the bone marrow dose for each photofluorography 30–40 pieces of 8 × 8 × 4.5 mm glass or LiF crystals were placed in adult and child phantoms at sites corresponding to the bone marrow. The results of approximately 40,000,000 exposures were used. The leukemia significant dose was calculated from data obtained from ABCC and Health and Welfare Statistics Division, Welfare Ministry. From these data, it was found that the yearly contribution of photofluorography to the leukemia significant dose in Japan per person is equivalent to 7.64 mrad for females and 7.83 for males, for a total of 15.15 mrad. These values are approximately 3.4 times the contribution made by radiography as estimated earlier. (auth)

22799 RADIOLOGIC EXPLORATION IN UROLOGY: PROTECTION AGAINST IONIZING RADIATIONS. Hernandez, Enrique Alvarez. Rev. Mex. Radiol., 17: 143-8 (Sept.-Oct. 1963). (In Spanish).

Precautions that must be exercised, when conducting radiologic explorations in urology, to minimize somatic hazards and genetic changes that may affect the embryo and fetus are discussed. (TCO)

Radiotherapy and Radiodiagnosis

Refer also to abstracts 22716 and 23541.

22800 (NIRS-4, pp 73-7) MEDICAL STUDIES. (National Inst. of Radiological Sciences, Chiba (Japan)).

A tracer method is described for studies of renal circulation in which ^{32}P is used for labeling red cells and ^{59}Fe, ^{147}Pm, or ^{198}Au are used for labeling plasma. Tracer methods for the diagnosis of hypoalbuminemia using ^{125}I-human serum albumin and ^{131}I-polyvinylpyroridone and for the study of metabolism in diabetic patients using ^{131}I-insulin are also described. Results are included from chromosome studies in cultured leukocytes of people exposed to

ionizing radiation under various conditions and whole-body counting of ^{40}K and ^{42}K in humans and plastic body phantoms to determine the effects of age on gross body composition. (C.H.)

22801 (JPRS-34501) UTILIZATION OF RADIOTELEMETRY FOR THE STUDY OF GASTRIC AND INTESTINAL TEMPERATURE IN MAN. Babskii, E. B.; Votchal, B. E.; Belousov, A. S. Translated from Terap. Arkh., 37: No. 2, 96-100(1965). 6p. (TT-66-30941). CFSTI $1.00 cy, $0.50 mn.

A radiotelemetric system for the transmissions of information concerning certain processes occurring within the body is described. The use and properties of thermal radiopills under clinical conditions are discussed. (H.G.D.)

22802 EFFECT OF BREATHING 5 PERCENT CARBON DIOXIDE AND 95 PERCENT OXYGEN AT ATMOSPHERIC PRESSURE ON TUMOR RADIOCURABILITY. Inch, W. R.; McCredie, J. A.; Kruuv, J. (Univ. of Western Ontario, London, Can.). Acta Radiol. Therapy, Phys., Biol., 4: 17-25(Feb. 1966).

Inhalation of 5% carbon dioxide and 95% oxygen at atmospheric pressure increased blood flow and x-ray sensitivity of the poorly vascularized C3H carcinoma isoimplant in the mouse compared with breathing 100% oxygen. The rate of cure of the C3HBA isotransplant, which has a better blood supply, was increased compared with air but not with pure oxygen. (auth)

22803 COMPLICATIONS IN RADIOIODINE TREATMENT OF HYPERTHYROIDISM. Edsmyr, F.; Einhorn, J. (Karolinska Sjukhuset, Stockholm). Acta Radiol. Therapy, Phys., Biol., 4: 49-54(Feb. 1966).

Early and late complications of the ^{131}I treatment of hyperthyroidism were examined in 2035 patients, 99.5% of whom were followed up for from 2 to 13 years. The initial reactions to the administration of ^{131}I and the treatments for them are discussed; the mortality is evaluated. (auth)

22804 A NEW DIAGNOSTIC TECHNIC IN UROLOGY: RENAL SCINTIGRAPHY. Timmermans, L. M. J.; Maquinay, C.; LeRoux, G. (Univ., Liege). Acta Urol. Belg., 32: 363-90(July 1964). (In French).

A new method of renal scintigraphy is illustrated in the treatment of 70 patients with congenital or acquired renal disease, with morphologic, functional, parenchymatous, or vascular disorders. Very little toxic effect was observed to result from this method. It is estimated that injection of 175 μC of $^{203}HgCl_2$ produces a dose of 153 rad in the kidney and, in women, 182 mrad in the ovaries; 175 μC of Neohydrin-^{203}Hg produces 76 rad in the kidney and 91 mrad in the ovaries. An injection of 1200 μC of $^{197}HgCl_2$ produces 3 rad in the kidney and 56 mrad in the ovaries. This dose is $\frac{1}{50}$th that of $^{203}HgCl$ and $\frac{1}{25}$th that of Neohydrin-^{203}Hg in the kidney. On the other hand, intravenous urography gives a gonadal dose of 500 mrad in women and 50 mrad in men. The sp act. of the $^{197}HgCl_2$ used was 2.7 to 8.3 C/g of Hg. An injection of 1000 to 1500 μC is comparable to 250 to 550 μg of stable Hg. It is concluded that the safety of the scanning method, its convenience, and wide applications are important factors to recommending this method. (TCO)

22805 PROBLEMS OF FLUOROSCOPIC TECHNIQUE. Frik, Wolfgang (Univ., Erlangen-Nuremberg, Ger.). Aerztl. Forsch., 18: 526-7(Oct. 10, 1964). (In German).

A viewing apparatus with a 39-cm picture tube is suggested for use during fluoroscopic examination of internal organs because it reproduces the image in the same size ratio as in conventional fluoroscopy. Advantages and uses of fluoroscopy are discussed. (TCO)

22806 LYMPHOGRAPHY AND PELVIC CARCINOMA: A DISCUSSION OF TECHNIQUE, APPLICATIONS AND IMPLICATIONS OF LYMPHOGRAPHY IN THE DIAGNOSIS AND TREATMENT OF CARCINOMA OF THE CERVIX. O'Leary, James A.; Friedman, Paul J. (Columbia-Presbyterian Medical Center, New York). Amer. J. Obstet. Gynecol., 92: 777-91(July 15, 1965).

Some aspects of lymphography pertinent to radiotherapy of tumor metastases in lymph nodes are considered. Properties of contrast media used in lymphography are compared. The problem of detecting tumor recurrence after radiotherapy by lymphography is discussed. It is suggested that the method is useful only as a prophylactic measure in treating microscopic carcinoma metastases in grossly abnormal nodes and should be used only as an adjunct to conventional radiotherapy. (TCO)

22807 VISUALIZATION OF THE PLACENTA BY RADIOISOTOPE PHOTOSCANNING USING ^{99m}Tc-LABELED ALBUMIN. Larson, Steven M.; Nelp, Wil B. (Univ. of Washington, Seattle). Amer. J. Obstet. Gynecol., 93: 950-6(Dec. 1, 1965).

Technetium-99m-labeled albumin was prepared and successfully used for placental localization in 16 patients during the third trimester of pregnancy. In each of the 16 patients, the position of the placenta and its relation to the lower cervical segment was visualized on the photoscan. Fetal plasma concentration of ^{99m}Tc was only 3% that of the maternal plasma concentration whereas when the free ^{99m}Tc-labeled ion was injected, the fetal plasma concentration of radioactivity was 70%. Radiation exposure of both maternal gonads and fetus was greatly reduced. (TCO)

22808 VALUE OF SERIAL SERUM ELECTROPHORETIC STUDIES FOR PROGNOSIS IN PATIENTS IRRADIATED FOR CARCINOMA OF THE CERVIX. Liebner, Edwin J.; Asrow, Gertrude; Vermeulen, Gerald D. (Univ. of Illinois, Chicago). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 864-70(Apr. 1966).

Serial serum electrophoretic studies over an appropriate interval can show patterns concerning the general condition of the patient and the efficacy of the treatment. If the age group, clinical state, and site of the cancer and volume of tissue irradiated are controlled, these serum patterns can become more meaningful for prognosis. It was found that the albumin and globulin values of patients with carcinoma of the cervix varied greatly from those of the normal controls. Pre-treatment findings were of little usefulness in discriminating between patients who obtained good and those who obtained poor results. By using both pre- and post-treatment values, the discrimination between those with good and those with poor results was significant ($p = .05$). A comparison was made in the Stage III and late Stage II carcinoma of the cervix cases between those having a favorable response and those who died. In patients responding favorably to radiation treatment, there was a mean decrease in α_2 globulin fraction, while in patients with unfavorable response, a mean increase in α_2 globulin fraction occurred ($p = .10$). The difference between patients with good and those with poor responses in the change in α_2 globulin fraction was significant at the .05 level. A rise in the albumin fraction and concomitant fall in the γ globulin fraction was considered a favorable pattern in the serial studies. (auth)

22809 POSSIBILITIES AND LIMITATIONS OF RADIOTHERAPY IN NEOPLASMS OF THE MOVABLE PORTION OF THE TONGUE. Capozzi, L.; Falcetti, E. (Istituto di Clinica Odontoiatrica, Perugia, Italy). Ann. Stomatol., 14: 343-68(May 1965). (In Italian).

Complications resulting from radiotherapy of oral tumors, with and without surgery, are described and their prevention discussed with reference to 70 cases. Epitheliomas of the tongue were treated by insertion of 2-mg Ra needles to give 5500- to 7500-R doses in 6 to 8 days. Seeds of ^{198}Au or x-ray therapy were used in other cases. Edema of the tongue with consequent impairment of eating and nutrition was a complication in some of the cases. The principal complications observed were hemorrhage and necrosis of soft tissue; the most serious bone lesion was mandibular osteoradionecrosis. With conventional x-ray therapy of the tongue, the relative absorption of radiation by mandibular bone is high. Obliteration of arteries supplying the bone by radiation is the major cause of this side effect. The dental lesions which accompany mandibular necrosis are also shown. Prophylactic measures to be considered are removal of infected teeth and use of antibiotics to prevent foci of infection developing. Interstitial radium treatment of tongue tumors provides less irradiation of jaw

bone than transcutaneous x-ray therapy, with less likely development of osteonecrosis. (TCO)

22810 EXTERNAL PARATHYROID SCANNING WITH ^{75}Se SELENOMETHIONINE. Potchen, E. James; Wilson, Richard E.; Dealy, James B. Jr. (Peter Bent Brigham Hospital, Boston). Ann. Surg., 162: 492-504(Sept. 1965).

Concentration of ^{75}Se-selenomethionine was demonstrated within a human parathyroid adenoma when a patient with hyperparathyroidism was given 200 μC of the isotope intravenously one hour before the tumor was removed. The specific activity of the parathyroid tissue was compared with that of suppressed thyroid, muscle, and blood, all removed simultaneously. The avidity of the parathyroid tissue for the isotope was striking. Localization by photoscanning methods was investigated in 18 patients. The patients, with one exception, were all prepared with triiodothyronine, 50 μg twice daily, for 2 to 8 days prior to scanning. The scans were performed with thallium-activated NaI crystal scanner and either of two 5-in. focussing collimators with 75% ^{131}I isoresponse. External scanning was started shortly after the injection and four serial tracings were made, the final one being completed between 90 and 120 min later. With these collimators, counting rates of 2500 to 3000 cpm were attained, with the spectrometer set to a window of 100 to 300 kev in an effort to utilize the 280-kev peak of ^{75}Se. In this series of 18 patients there was excellent correlation in 13 patients. (TCO)

22811 INVESTIGATION OF THE EFFECT OF FRACTIONATED REGIMES OF IRRADIATION IN NORMAL TISSUES. Wiernik, George (St. Thomas's Hospital, London). Brit. J. Radiol., 39: 272-9(Apr. 1966).

Different fractionated regimes of γ irradiation used in the post-operative treatment of carcinoma of the stomach were assessed by their effect on normal tissue. The mucosa of the small intestine was used for this purpose. A regime consisting of a few large fractions was found to cause excessive damage through their inopportune spacing. Treatment by an increased number of smaller fractions was associated with evidence of repair of the normal tissue damage despite continued irradiation. The implications of this with respect to the radiation effect in tumors are discussed. An experimental fractionation regime incorporating a few large fractions but avoiding excessive immediate normal tissue damage by suitable spacing of the fractions is reported. Serial peroral jejunal biopsies were obtained prior to and during the course of irradiation so that each treatment was given only after evidence of repair of the damage resulting from the previous dose had been observed. By this means a normal mucosal pattern was preserved immediately following treatment and was still present 18 months later, though this time interval is not considered adequate to exclude the development of late radiation damage. (auth)

22812 THE ATTENUATION AND SCATTERING IN A PHANTOM OF GAMMA RAYS FROM SOME RADIONUCLIDES USED IN MOULD AND INTERSTITIAL GAMMA-RAY THERAPY. Meredith, W. J.; Greene, D.; Kawashima, K. (Christie Hospital, Manchester, Eng.). Brit. J. Radiol., 39: 280-6(Apr. 1966).

Ionization chamber measurements in air and in a phantom show that scatter does not quite compensate for attenuation, as assumed in the Paterson-Parker dosage system, for the γ rays from ^{226}Ra + daughters, ^{198}Au, ^{192}Ir, ^{182}Ta, ^{137}Cs, and ^{60}Co. Exposures within the patient are slightly, but not clinically significantly lower, than predicted, while the increase of surface doses due to back-scatter is also very small. All these isotopes can be used equally well for molds or implants. (auth)

22813 TISSUE CORRECTION IN ^{60}Co ROTATION TREATMENT CALCULATIONS. Smith, V. (St. Bartholomew's Hospital, London). Brit. J. Radiol, 39: 287-90(Apr. 1966).

The use of tissue correction factors in ^{60}Co rotation treatment planning was investigated and the simple exponential correction is rejected in favor of a more accurate empirical correction. A computer was used to evaluate a specimen plan using both methods of correction and the dose distribution given by each method is compared with an experimentally determined distribution. The values to be used in the empirical correction are discussed. (auth)

22814 PHOTOCONDUCTIVE DOSEMETER FOR MEASUREMENT OF RADIUM DOSAGE. Bryant, T. H. E. (Middlesex Hospital Medical School, London). Brit. J. Radiol., 39: 291-4(Apr. 1966).

The physical characteristics and applications of a simple robust and sensitive single crystal cadmium sulfide probe suitable for direct measurement of rectal and bladder doses received during gynaecological radium insertions are described. (auth)

22815 THE APPLICATION OF A RADIOACTIVE SCANNING TECHNIQUE IN DISEASES OF THE LIVER. Torrance, H. B.; Isbister, W. H.; Mitchell, G. (Manchester Royal Infirmary, Eng.). Brit. J. Surg., 52: 813-16(Oct. 1965).

A new method of liver scanning was developed that uses ^{131}I-labeled heat-denatured albumin (HDA) prepared from normal human serum albumin by incubation in a water bath at a fixed temperature, until a fixed increment in optical density occurs. The denaturing process results in the aggregation of the protein molecules. On intravenous injection, this material rapidly disappears from the circulation having been taken up by the reticuloendothelial cells in the liver and spleen. The efficiency of extraction of a single circulatory transit through the liver is ~90%. Following intravenous injection of ^{131}I-labeled HDA, liver extraction is complete within 8 min, and the background activity from blood and other tissues is virtually zero. The liver activity remains at a constant plateau level for at least 40 min. This material is extracted from the sinusoidal blood within the liver by the reticuloendothelial cells and is not taken up by tumor tissue. HDA offers certain advantages over other isotopically labeled compounds which have been previously used for liver scanning. To carry out the procedure, ~75 μC of ^{131}I–HDA is injected intravenously, the patient having been given a large dose of inorganic iodide over the previous 48 hr. Scanning procedures are described, and use of the method in 46 patients is reported. Satisfactory results were attained with 42 of the 46 patients. (TCO)

22816 CRITICAL CONSIDERATION OF THE VALUE OF THE DESTRUCTION OF THE PITUITARY GLAND BY RADIOGOLD IMPLANTATION IN METASTASIZING BREAST CANCER. Schnepper, Elmar; Cramer, Hans (Univ., Muenster/Westfall, Ger.). Bruns' Beitr. Klin. Chir., 209: 184-92(Sept. 1964). (In German).

Use of ^{198}Au for pituitary inactivation in 90 patients is reported, with data on clinical results and side-effects. Complications are described, and hypophyseal destruction by implantation of radiogold is compared with surgical excision. Limitations of radiogold therapy are pointed out. Results with the application of the usual maximal doses of 30 to 45 mC show that patients with far advanced metastases, especially metastases within parenchymal organs, are generally not benefited for a long period of time. Because of the danger of radiation injuries and complications, careful selection of patients is recommended. (TCO)

22817 A NEW METHOD OF SCINTIGRAPHIC REPRESENTATION OF THE SPLEEN WITH BROMO-MERCURI-HYDROXYPROPANE (^{197}Hg-BMHP). Schwartz, K. D.; Knoll, P.; Hamann, D. (Univ., Rostock, Ger.). Deut. Gesundheitsw., 20: 737-42(Apr. 29, 1965). (In German).

The distribution of ^{197}Hg-labeled bromo-mercuri-hydroxypropane (BMHP) in rats was studied after intravenous injection. The uptake of BMHP in kidney was higher than in spleen, and there was considerable uptake in the liver, parotid gland, small intestine, large intestine, and in feces. Concentrations in bone were three times as high as in muscle. The results were also studied grossly by autoradiography, and the distribution pattern was found to be similar. The BMHP disappeared from the kidney cortex more slowly than from the spleen and other organs. Concentrations of the BMHP measured scintigraphically in 20 patients

were similar to the results found in rats. Use of ^{197}Hg-labeled BMHP for scanning of the spleen is compared to that of ^{51}Cr-labeled red cells. (TCO)

22818 RADIOTHERAPEUTIC TECHNIC AND TACTICS IN THE REGION OF THE FACE, ORAL CAVITY, AND NECK. **Gauwerky, Friedrich (Allgemeines Krankenhaus St. Georg, Hamburg). Fortschr. Kiefer- Geisichtschir., 8: 50-65(1962). (In German).**

Use of conventional and ultrahard x rays, fast electrons, ^{60}Co γ radiation, and contact therapy with Ra to treat cancers of the head is discussed with particular attention to doses used, dose distribution, and prevention of radioinduced injuries. Isodose patterns and treatment plans are described and indicated for various types of radiation and locations of tumors. Various details are illustrated by the treatment of carcinomas of the lower lip, tongue, tonsil, and maxillary antrum. Selected results of treatment are shown. Radiosensitivity of the various tissues of the facial region is discussed. (BBB)

22819 THE PROBLEMS ENCOUNTERED IN FOUR YEARS' EXPERIENCE OF TREATING CARCINOMA OF THE CERVIX WITH ^{60}Co. **Hartman, G. V. (Christian Medical Coll., Ludhiana, India). Indian J. Cancer, 2: 149-52(Sept. 1965).**

Complications arising from radiotherapy of cervical cancer in 553 patients are described. Modification of the irradiation technique so as to minimize injuries is discussed. (TCO)

22820 NUCLEAR PHARMACEUTICALS—THEIR DEVELOPMENT, PREPARATION, AND APPLICATIONS. **Herzmann, H. (Inst. for Applied Isotope Research, Berlin). Isotopenpraxis, 1: 45-52(Nov. 1965). (In German).**

A bibliographic review is given of the development, preparation, and applications of nuclear pharmaceuticals. The use of nuclear pharmaceuticals in diagnosis and therapy is considered. (66 references.) (J.S.R.)

22821 THE QUESTION OF IRRADIATION THERAPY IN LUNG CANCER. **Krant, Melvin J. (Lemuel Shattuck Hospital, Boston). J. Amer. Med. Ass., 195: 471-5 (Feb. 7, 1966).**

The development of radiotherapy for lung cancer is reviewed historically, and the advantages and disadvantages of the technique are evaluated. Dosimetry is identified as a prime factor in complications arising from lung cancer therapy. (TCO)

22822 RADIATION THERAPY FOR LAMENESSES IN HORSES. **Clapp, N. K.; Carlson, W. D.; Morgan, J. P. (Colorado State Univ., Fort Collins). J. Amer. Vet. Med. Ass., 143: 277-80(Aug. 1, 1963).**

Large animal lameness was treated with a single 1000 R application of ^{60}Co γ radiation. Results of x irradiation and ^{60}Co γ-ray therapy for certain types of lameness in 55 horses are reported. Using ^{60}Co needles in a rubber-tubing mold permitted therapeutic exposure to approximately 60 cm^2 of surface area. Protective shielding during the administration of x-ray therapy and isolation of the horse during ^{60}Co therapy was used to avoid unnecessary radiation hazards to personnel. Lameness existed for an average of 4 months prior to irradiation. Recovery could possibly have been significantly higher if radiotherapy had been used immediately following the onset of lameness. (TCO)

22823 RADIOISOTOPE SCANNING OF THE KIDNEYS WITH ^{203}Hg LABELED CHLORMERODRIN. **Ganatra, R. D.; Sharma, S. M.; Ramnath, P.; Satoskar, R. S. J. Ass. Physicians India 12: 815-19(1964).**

The technique of radioisotope scanning of the kidneys after an infection of chlormerodrin-^{203}Hg (Neohydrin) is described. The usefulness of the technique in clinical diagnosis is discussed. (auth)

22824 INTEGRAL AND GONAD RADIATION DOSES IN RADIOISOTOPE RENOGRAM AND RADIOGRAPHIC INTRAVENOUS PYELOGRAM EXAMINATIONS. **McEwan, A. C. (National Radiation Lab., Christchurch, N. Z.). J. Coll. Radiol. Austral., 10: 55-63(Feb. 1966).**

Integral and gonad radiation doses in radioisotope renogram using ^{131}I-hippuran and radiographic intravenous pyelogram (IVP) examinations were assessed using methods which are considered to be of general application. The calculated values indicate that the integral dose in a renogram examination is about one-ten thousandth of that in an average IVP and that the gonad doses are only of the order of the daily dose from natural background radiation. It was also shown that if thyroid uptake of free iodine present in the test material is not prevented by first administering a saturation dose of non-radioactive iodine, the integral dose from a renogram examination could be increased by a factor of up to about 10. (auth)

22825 EFFECT OF ROENTGEN RAY TREATMENT OF GYNECOMASTIA IN PATIENTS WITH PROSTATIC CARCINOMA TREATED WITH ESTROGENIC HORMONES: A PRELIMINARY COMMUNICATION. **Alfthan, Olof; Kettunen, Kalevi (Maria Hospital, Helsinki). J. Urol., 94: 604-6(Nov. 1965).**

The action of low-energy x-ray therapy on hypertrophied breast tissue was examined in 25 men receiving large doses of estrogen (polyestradiol phosphate) for prostate cancer. A single skin dose of 1425 or 2375 R to the areola resulted in a moist exudative erythema with the dose of 2375 R. When the dose was reduced to 1425 R, only mild dry desquamative erythema appeared. Seventeen patients already had gynecomastia before x-ray therapy was started. As a rule, both doses effected relief of soreness and pain. Only a fair or indefinite regression of gynecomastia was obtained in 8 cases. In the remaining 9 cases enlargement of the breasts persisted. Eight patients received an irradiation dose on the day that hormone therapy was instituted. Gynecomastia was prevented in all of these cases. The irradiation dose was 2375 R in two cases and 1425 R in 6 cases. Thus, even 1425 R, given as a single treatment, seemed to be sufficient to prevent enlargement of the mammary gland in male subjects treated with estrogens. However, the observation time is probably too short and the number of cases too small for final evaluation. If higher doses prove necessary, these should be fractionated to avoid severe skin reactions. (TCO)

22826 USE OF A SCINTILLATION CAMERA IN CLINICAL DIAGNOSTIC STUDIES. **Scheer, K. E.; zum Winkel, K. (Deutsches Krebsforschungszentrum, Heidelberg. Univ., Heidelberg). Minerva Nucl., 9: 386-90 (Nov.-Dec. 1965).**

A scintillation camera with an 11 in. diameter crystal was used for radioisotope functional studies in kidney and liver, and localization of brain tumors. The instrument allows a topographic recording of rapidly changing distributions of radioactive material within the organs. In vascular renal diseases a delayed fixation of radioactive material on the affected side without differences in the maximum of activity was observed. In chronical pielonephritis and in chronical obstructions of the upper urinary tract differences of the behavior of iv injected radio-hippuran was observed where no differences could be seen in the conventional kidney-scan or using isotopenephrography. In the case of liver diseases differences between intracellular hepatitis and biliary obstruction were observed. (auth)

22827 PRECISION APPARATUS FOR THE ADMINISTRATION OF THERAPEUTIC DOSES OF GAMMA-EMITTING RADIONUCLIDES WITH A DISTANT COMMAND MOTOR-DRIVEN BURETTE. **Lin, Sergio (Ospedali Riuniti, Trieste, Italy). Minerva Nucl., 9: 476-82(Nov.-Dec. 1965). (In Italian).**

A new system for the preparation of therapeutic doses of radionuclides is described. This apparatus includes a remote-control motor-driven burette coupled to a mechanical system regulating its movements in a shielded cell. An apparatus used to fix and light the bottles containing the radioisotopes and a shielded trolley in which the single therapeutic doses are kept are also described. (auth)

22828 RADIOACTIVE ISOTOPE SCINTISCANNING. **Loken, Merle K. (Univ. of Minnesota Hospital, Minneapolis). Minn. Med., 48: 1138-43(Sept. 1965).**

The use of ^{131}I, ^{198}Au, ^{51}Cr, ^{197}Hg, ^{203}Hg, ^{75}Se, ^{85}Sr, and ^{87m}Sr for scanning of various organs is reviewed. Clinical

success in localizing expanding lesions (both malignant and benign) was reported to be 85%. Fair success was obtained in visualization of the pancreas using selenomethionine in which the sulfur atom was replaced by ^{75}Se to provide the necessary γ emissions. This technique is considered to be a useful adjunct to available diagnostic procedures for study of pancreatic disease. The total-body radiation dose to the patient receiving 3 μC of selenomethionine per kg body weight (the usual dose for a pancrease scan) is estimated to be about 600 mrad. Pancreozymin, secretin, and high protein diet have been used to selectively increase the uptake of selenomethionine by the pancreas. Following the administration of the isotope, glutamic acid hydrochloride can be administered to inhibit the pancreas and thus slow down the release of the radioactivity by this organ. Use of radiostrontium to study bone lesions is also considered. (TCO)

22829 RADIATION THERAPY OF ORBITAL TUMORS. **Scherer, E.; Halama, J. (Univ., Muenster, Ger.). Muenchen. Med. Wochschr., 106: 1976-82(Oct. 30, 1964). (In German).**

Clinical and therapeutic results of irradiation of primary orbital tumors, tumors extending to the orbit, and orbital metastases, with a ^{137}Cs source of 2000 C are presented. Advantages of cesium-137 irradiation use are: delivery of less irradiation to skin, reduction of the volume or integral dose; and improvement of the absorption differences between soft tissues and bone. The patients treated received focal doses of from ~4400 to 6500 R. Survival times after irradiation ranged from 2 to 39 months, depending on whether the tumors were so advanced that they required surgery in addition to irradiation. The prognosis for these patients was poorer than for those that did not require surgery. Several of the patients became free of symptoms after irradiation. Tumors that had a lymphoreticular origin were very radiosensitive. Tumor metastases, especially from mammary carcinoma were favorably affected by irradiation. (TCO)

22830 INVESTIGATIONS OF LEUKOCYTE KINETICS IN NORMAL AND LEUKAEMIC INDIVIDUALS BY MEANS OF SCINTILLATION COUNTING. **Perry, Seymour; Moxley III, John H. (National Cancer Inst., Bethesda, Md.). Nature, 209: 882-4(Feb. 26, 1966).**

Tritiated thymidine was used for an investigation of in vivo leucocyte kinetics in normal and leukemic individuals. The tritiated thymidine (specific activity 1.9 C/mmole) was given intravenously at doses ranging from 40 to 100μC/kg body weight. Blood samples were obtained, leucocytes isolated and centrifuged, and the cell button hydrolyzed and an aliquot counted in a liquid scintillation spectrometer. In hematologically normal individuals a low level of radioactivity was present for the first three days, but on the fifth day the level began to rise and reached a peak on the seventh or eighth day. In patients with chronic myelocytic leukemia the curve was more complex. Heavy labeling was present immediately after the administration of the isotope. The level of radioactivity then declined in the first 10 hr but rose to an initial peak at 24 to 40 hr. Another peak occurred between 50 and 60 hr and a third peak at 5 to 7 days after administration of the isotope. (M.C.G.)

22831 EFFECT OF THE COMBINED TREATMENT OF RADIATION AND CARCINOSTATIC AGENTS ON YOSHIDA-SARCOMA CELLS. **Saito, Toshitaka (Tokyo Medical and Dental Univ.). Nippon Acta Radiol., 25: 908-29(Nov. 1965). (In Japanese).**

Rats into which Yoshida-sarcoma cells had been inoculated were treated by radiation and/or carcinostatic agents. Then, Yoshida-sarcoma cells obtained from the rats were transplanted to normal rats. The therapeutic effect of the radiation and/or carcinostatic agents was evaluated by mean survival time of the latter rats. The results give a suggestion of the behavior of the metastasis after treatment of the primary lesion and support clinical experience indicating that the treatment of cancer should be directed not only toward destroying the malignant cells but also toward maintaining the good general condition of the host. (auth)

22832 DOSE DISTRIBUTION CALCULATED BY MONTE CARLO METHOD. **Okumura, Yutaka (Research Inst. Aichi Cancer Center, Japan). Nippon Acta Radiol., 25: 1018-21(Nov. 1965). (In Japanese).**

Dose distribution was calculated by a Monte Carlo method for telecobalt fixed-field irradiations of various field sizes. Since the gamma source was assumed to be a point, the calculated isodose curve was quite different from the experimental curve near the edge of the field, but calculated and experimental central dose distributions agreed well. An experimental transformation equation can be used to obtain three-dimensional depth dose curves from the two-dimensional calculations. (TCO)

22833 CLINICAL AND SCINTIGRAPHIC FINDINGS IN RADIATION MYOSITIS COMPLICATING THE INTRAPERITONEAL ADMINISTRATION OF ^{198}Au. **Nemec, J.; Kubal, J.; Vohnout, S.; Schubert, J.; Sudek, J.; Sebek, V. (Hospital Motol, Prague). Nucl.-Med., 5: 188-96(1966).**

Intraperitoneal administration of colloidal ^{198}Au complicating the treatment of an ascitic ovarian cancer is reported. Typical scintiscans and various clinical findings of muscle necrosis and radiation myositis are described. Administration of larger amount of saline solution preceding the radiogold instillation controlled by simultaneous scintiscanning are suggested as safety measures in patients when no ascitic fluid is present. (auth)

22834 MODIFIED AUTORADIOGRAPHIC TECHNIQUE FOR MARGINAL PENETRATION STUDIES. **Kapsimalis, Peter; Evans, Richard; Tuckerman, Murray M. (Temple Univ. School of Dentistry, Philadelphia). Oral Surg., Oral Med., Oral Pathol., 20: 494-504(Oct. 1965).**

Factors that regulate the sharpness of the autoradiographic image were examined with a view to obtaining better reproductions of the radioactivity. Tests were conducted with ^{35}S, $^{3}H_2O$, ^{3}H-glucose, and ^{3}H-proline. These studies concerned the marginal penetration of radioisotopes between filling material and tooth and in studies of the permeability of tooth substance. Optimal immersion concentrations and times were determined for each of the radioactive solutions. Photographic glass-plate emulsions provided a more intimate contact with the tooth specimen than did the dental x-ray film. The improved technique uses a composite autoradiograph, localizing the exposure area to the tooth specimen by passing a combination of reflected and transmitted light through the clear photographic glass plate. Under high magnification, black and white or colored photographs can be made and the path and depth of isotope penetration into tooth substance can be more accurately related to the autoradiograph. A 300-μ tooth specimen produced a sharper autoradiograph than the usual 1 mm specimen. Serial sections taken from the same test tooth showed different patterns of isotope penetration, raising the question of the reliability of a single-section result. Critical maximal and minimal isotope concentrations and processing times must be predetermined in order to produce an accurate image of the activity in the tooth. (TCO)

22835 A NEW METHOD OF ESTIMATING ^{131}I CONVERSION RATIO AND $PB^{131}I$. **Czech, W. (Postgraduate Medical School, Warsaw). Pol. Endocrinol., 14: 1-8 (1963).**

A new method is presented for determination of the conversion coefficient with ^{131}I and $PB^{131}I$. The method is based on the principle of uniform distribution of the inorganic ^{131}I in the supernatant and in the protein precipitated with a mixture of 30% CCl_3COOH and methanol in the ratio 2 : 1. Advantages of the new technique over methods using ion-exchange resins or over the classical method are simplicity and time conservation. (H.G.D.)

22836 HISTOAUTORADIOGRAPHIC INTEREST IN THYROIDAL PATHOLOGY. **Berger, J.; Yaneva, H.; Vallee, G. (Hopital Necker, Paris). Probl. Actuels Endocrinol. Nutr., No. 8, 275-88(1964). (In French).**

Histoautoradiographic studies made of 60 cases of human thyroid pathology are reported. Iodine-131 or ^{125}I was administered 24 or 48 hr prior to sampling of thyroid tissue.

The histoautoradiographic resolution was better in tissues containing the ^{125}I. Comparisons were made between normal tissue, cells with nonhomogeneous distribution of ^{131}I, confluent cells observed in colloidal goiter, and intracellular, intravascular, and interstitial deposition of ^{131}I. Representative tissue from thyroid carcinomas, adenomas, goiters, Hashimoto's disease, and cysts are compared. (BBB)

22837 SURGERY OF CANCER OF THE UPPER AERODIGESTIVE TRACT FOLLOWING RADIOTHERAPY. **Cachin, Y. (Institut Gustave Roussy, Villejuif, France). Problem. Actuels Oto-Rhino-Laryngol., 119-30(1964). (In French).**

Hazards of surgery following radiotherapy of the upper respiratory-digestive tract are discussed. It is suggested that surgery may give rise to: impairment of healing processes, infections, hemorrhaging, or lesions. The relationship between therapeutic dose and incidence of complications is considered. Time intervals between radiotherapy and surgery that are most favorable to successful results are included. (TCO)

22838 SUPPLEMENTAL TREATMENT AND POST TREATMENT OF MAMMARY CARCINOMA. **Diethelm, L. (Univ., Mainz). Radiol. Austr., 15: 199-208(1964). (In German).**

Methods for supplementing radiotherapy of mammary carcinoma are discussed. Treatments considered are: subtractive hormonal treatment by castration or hypophysectomy; additive hormonal treatment with androgens and estrogens; treatment with cytostatic agents; general improvement of body defense mechanisms; improvement of irradiation tolerance, and use of substances for treatment of localized irradiated areas. (H.G.D.)

22839 ON THE POSTOPERATIVE IRRADIATION OF MAMMARY CARCINOMA WITH X-RAY-TELECOBALT. **Fridrich, Raimund (Institut fuer Roentgendiagnostik, Basel). Radiol. Austr., 15: 219-24(1964).**

In a series of 167 patients in Stage II of mammary carcinoma treated with ~2000 to 5000 R of combined x and telecobalt radiation and surgery, 40% suffered from recurrences in the areas irradiated, within 5 yr. This was an improvement of 27% compared to 60% of those who were x irradiated only. Compared to results reported from other clinics this represents a definite improvement in treatment. The improvement may have been due to destruction of locally distributed tumor cells and destruction or blocking of lymphatic drainage vessels. It is probable that the improved rates of cure observed at the higher doses was related to irradiation of the parasternal and supraclavicular lymph nodes, because these have been reported to be very susceptible to tumor infiltration. Surgical removal alone of these nodes improves results only ~10%, but when irradiation is also used then the results are ~20 to 30% improved. Although the axillary region can be irradiated adequately with conventional crossfire x irradiation, it is difficult or almost impossible to reach the mediastinal lymphatic drainage area by this method. With telecobalt irradiation it is possible to reach the parasternal and mediastinal lymphatic areas. In addition, the supraclavicular and the lower neck lymph nodes can be irradiated with telecobalt, obtaining a steep dose decrease in depth by shortening of the source-to-skin distance. (BBB)

22840 NUCLEAR MEDICINE: PRESENT AND FUTURE. NEW HORIZONS FOR RADIOLOGISTS LECTURE. **Wagner, Henry N. Jr. (Johns Hopkins Medical Institutions, Baltimore). Radiology, 86: 601-14(Apr. 1966).**

The role played by nuclear medicine in solving biomedical problems is reviewed, and the use of radioisotope techniques by the diagnostic radiologist is discussed. Topics considered include: tracer techniques, nuclear instrumentation, radiopharmaceuticals, and radiography. (H.G.D.)

22841 APPLICATIONS OF THE GAMMA-RAY SCINTILLATION CAMERA TO DYNAMIC STUDIES IN MAN. **Rosenthall, Leonard (Montreal General Hospital). Radiology, 86: 634-9(Apr. 1966).**

Applications of the gamma scintillation camera to dynamic studies in man are discussed. Using ^{99}Tc-pertechnetate injected intravenously in 5 to 10 mC quantities, the major arterial supply in the head, neck, thorax, and abdomen may be traced in serial five second imaging intervals. Diagnostic studies of the thorax, renal blood flow, abdominal aorta, common iliac artery, and carotid blood flow are illustrated. (H.G.D.)

22842 STUDY OF THYROID FUNCTION WITH ^{132}I AFTER TREATMENT OF THYROTOXICOSIS WITH ^{131}I. **Malamos, B.; Binopoulos, D.; Kostamis, P.; Koutras, D. A. (Alexandra Hospital, Athens). Rev. Med. Moyen-Orient, 20: 405-11(Sept.-Oct. 1963). (In French).**

Incorporation of ^{132}I was measured 2 hr after administration to 34 hyperthyroid patients treated previously with ^{131}I. The uptake results were compared with the eventual clinical condition of the patients. The over-all results indicated that uptake results carried out immediately after the treatment of thyrotoxicosis could not be a basis of prediction of actual clinical condition or indicate whether additional ^{131}I treatment would be required. (BBB)

22843 QUANTITATIVE STUDY OF THE PRECIPITIN REACTION BY GAMMA-RADIOACTIVE TRACERS. **Bonev, L.; Todorov, S.; Robev, S. (Inst. of Scientific Research of Radiology and Radiation Safety, Sofia). pp 379-83 of STI-PUB-106. (In Russian).**

Results are reported from quantitative determinations of the precipitin reaction (formation of an antigen-antibody complex) by labelling the precipitating components with gamma-radioactive tracers which do not chemically interact with albuminous molecules. Chrome-manganese compounds doubly labeled with ^{51}Cr and ^{59}Fe whose tendency to hydrolyze permits the fixation of the radioactive tracer on the antigen and antibody respectively, were used. The radioactivity of the components was determined by a multichannel pulse-height analyzer. The results obtained show that the precipitation curve, plotted on the basis of radiometric data, closely corresponds to the curve plotted by the well-known quantitative methods used to determine albumin. Possible clinical applications of the method are discussed. (auth)

22844 CLINICAL EXPERIENCES WITH A NEW METHOD FOR DOSE PLANNING AND THERAPY SIMULATION IN RADIOTHERAPY. **Setaelae, Kai (Univ., Helsinki). Strahlentherapie, 129: 391-405(Mar. 1966). (In German).**

Results are presented from measurements of the depth-dose distribution along the central axis of the x radiation beam, utilizing only a single irradiation field in orthovolt therapy and in supervolt therapy, with special emphasis on the effect of turning of the position of the lying patient. Treatment planning and determination of the irradiation dosage were carried out by means of automatic devices and a therapy simulator of new type, and employing conventional isodose charts. It became evident that turning of the lying patient resulted, among other things, in alterations in the tissue volume up to 1,500 ml within the irradiation beam; and an error in the depth-dose distribution. In orthovolt therapy the degree of the maximal error amounted to 150% and in supervoltage therapy the average error was of an order of 35%. A displacement of the exit portal of the central ray; and sources of error were specially manifold in betatron irradiation. In numerous instances the alterations were of such a high degree that an exact determination of the irradiation dosage became difficult, or was impossible to carry out. (auth)

22845 THE RADIATION EXPOSURE OF PATIENTS AND RADIOLOGICAL EMPLOYEES IN HEART SOUNDINGS AS WELL AS CONTRAST MEANS REPRESENTATION OF THE HEART AND THE LARGE BLOOD VESSELS. PART III. DISCUSSION OF THE MEASURED RESULTS—LITERATURE. **Schulte-Brinkmann, Wolfgang (Univ., Duesseldorf). Strahlentherapie, 129: 460-71(Mar. 1966). (In German).**

The skin and male gonadal dose received by 100 patients having heart soundings with image intensifier television transillumination and in 110 bi-plane angiocardiographic

procedures using large film size were determined. The values were compared with the ones published in the literature and correlated to age, body size, and body weight. In the same way, results obtained at a film box changer in 42 lumbal aortographies and 42 peripheral veinographies were discussed. Exposures of physicians and aides to the scattered radiation were measured over the lead-rubber-apron during numerous heart soundings as well as during angiocardiographic procedures. Using the average results for each type of examination and from the number of examinations in the year 1963, the annual scattered radiation exposure at the thorax (corresponding to the total-body exposure) and at the hands could be calculated. Protective clothing and number of persons involved were considered. Direct measurements of the scattered radiation exposure of physicians were done under the lead-rubber-apron in 138 examinations. Smaller exposure values than calculated were obtained, caused mainly by a frequent use of 2 lead-rubber-aprons (protective value 0.5 mm Pb). The total-body and partial-body exposure during heart soundings and examinations of the heart and the larger vessels with contrast medium can be considered as small when compared to the present maximum permissible radiation dose for radiological personnel. Procedures for a further dose reduction are discussed. (auth)

22846 RADIOISOTOPE FINDINGS ON THE STOMACH. **Severin, Gerhard; Wolf, Rudolf (Univ., Mainz). Strahlentherapie Sonderbaende, 57: 212-16(1964). (In German).**

The use of ^{131}I was studied for its value as a scintigraphic agent for detection of gastric ulcers and carcinomas. The scans were performed at 1, 3, 7, and 24 hr following administration of 300 to 350 μC of ^{131}I. In seven normal persons no scintigraphic image of the stomach could be obtained. Out of seven patients with stomach ulcer, concentration of ^{131}I could be demonstrated in only 2 after 24 hr. Of a total of 16 patients with clinically and radiologically diagnosed stomach carcinoma, 10 showed concentration of ^{131}I. In 11 cases of surgically confirmed stomach carcinoma, eight showed positive evidence of ^{131}I concentration in the stomach, and in nine histologically verified cases, six also gave scintigraphic confirmation. The results indicated that ^{131}I given intravenously could be used as a scintigraphic agent to obtain suggestive evidence of malignant changes in the stomach. However, in view of the relatively few studies that have been made with this approach, the fact that a positive scintigraphic result is not obtained does not exclude the possibility of a neoplasm. (BBB)

22847 ON POSTOPERATIVE RADIATION OF MALIGNANT TUMORS. **Bohndorf, W. (Universitaets-HNO-und Hautklinik, Wuerzburg, Ger.). Therap. Genew., 104: 473-9(Apr. 1965). (In German).**

With few exceptions there is no way to provide for a truly prophylactic irradiation of a problastomal melanosis that will prevent recurrence of the tumor. Irradiation can only destroy tumor cells in the immediate area of surgery or in the regional lymphatics. The methods of irradiation and the dose required for problastomal melanosis are discussed. According to the type of tumor, a focal dose of from 4000 to 7000 R is required. For mammary carcinoma the cure rate can be increased by 10% if irradiation treatment is given postoperatively. In bronchial carconoma two complete series of single 150 to 200 R doses/field are required to destroy latent mediastinal metastases. A similar treatment, with total dose of 5000 to 6000 R is necessary for postoperative treatment of brain tumors. Because of its relative radiosensitivity, metastases of testicular seminomas in the iliac and paraaortic lymphatics should be promptly irradiated with 4000 to 5000 R. (TCO)

22848 ^{99m}Tc IN THE DIAGNOSIS OF LEFT-TO-RIGHT SHUNTS. Clarke, J. M.; Deegan, T.; McKendrick, C. S.; Herbert, R. J. T.; Kulke, W. (Sefton General Hospital, Liverpool). Thorax, 21: 79-82(Jan. 1966).

The recent availability of ^{99m}Tc, a daughter isotope of ^{99}Mo, whose disintegration characteristics allowed for larger doses to be administered, prompted an appraisal of the detection of intracardiac shunts by external counting. Disintegration characteristics enable much larger doses to be administered than in the case of ^{131}I and similar isotopes. The half layer value in tissue for ^{99m}Tc and its localization and excretion characteristics result in reduced radiation detection from underlying vessels. Collectively, the ability to obtain higher counting rates by the administration of larger amounts of ^{99m}Tc, together with the increased definition of the area monitored, increases the accuracy of the technique compared with the use of other isotopes. An additional advantage of ^{99m}Tc is the small amount of screening required for detector heads. Maximum counting rates with doses of 1 mC of ^{99m}Tc were within the range of 700 to 900 pulses per second in normal subjects, and definite secondary circulation peaks were evident. Patients with left-to-right shunts, proved by catheterization, provided curves in which the maximum counting rate was lowered (400 to 600 pulses per second) and the clearance rate of isotope was reduced to the exclusion of a definite recirculation peak. (TCO)

22849 ON THE THERAPY OF POLYCYTHEMIA VERA. **Hoelzer, Erika (Karl-Marx-Univ., Dresden). Z. Aerztl. Fortbild., 58: 929-33(Aug. 15, 1964). (In German).**

Treatment of polycythemia vera with ^{32}P was compared with x irradiations. Treatment with ^{32}P has the advantages that vascular complications are rare, toxic side effects are slight, and the periods of remission obtained are longer. Following the first injection of ^{32}P the duration of remission has been reported to be from 19 to 24 months. The patients treated by the authors showed remissions that extended from 12 to 43 months with an average value of 36 months. When patients with polycythemia vera were x irradiated, remissions of from $1\frac{1}{4}$ to 3 yr were obtained. However, x-irradiation treatment is now largely used only in patients who are resistant to ^{32}P therapy. In addition, because good results can be obtained only if whole-body irradiation is used, the irradiation burden is quite large. Only one case of myelofibrosis was observed in the patients, although it has been suggested that this condition may normally be a subsequent stage of polycythemia vera. (BBB)

22850 SOME EXPERIENCE WITH RADIOPHOSPHORUS THERAPY OF POLYCYTHEMIA VERA. **Hennig, Konrad; Franke, Wolf-Gunter; Strietzel, Manfred (Medizinische Akademie Carl Gustav Carus, Dresden). Z. Gesam. Inn. Med. Ihre Grenzg., 20: 14-20(Jan. 1, 1965). (In German).**

Use of ^{32}P to treat 40 patients with polycythemia vera is reported, and data are presented on the clinical results and side-effects. The average initial dose was 5.1 mC. Full remission was obtained in 31 cases with one dose, whereas four patients required a second dose and five a third dose of ^{32}P. The duration of remission averaged 2.3 yr and ranged from three months to 4.5 yr. Leukopenia, which accompanied the desired fall in red cell counts, was a problem in several cases. Peripheral blood circulation was improved in cases where initially it was poor on account of arteriosclerosis, presumably because of lowered viscosity of blood, at least in part. The question of whether leukemia or bone marrow fibrosis are important side-effects of ^{32}P treatment is examined. The possibility that polycythemia itself may lead to myelofibrosis in its late stages makes it difficult to evaluate the role of ^{32}P in inducing this late complication. Even though ^{32}P may be implicated as a cause of leukemia, its life-prolonging effect in polycythemia may offset the importance of this hazard. (BBB)

22851 PRINCIPLES OF RADIOGRAPHIC EXPOSURE AND PROCESSING. **Fuchs, Arthur W. Springfield, Ill., Charles C Thomas Publisher, 1966. 300p.**

A training manual was developed for x-ray technicians. Featured is a simple though exact exposure system based upon proven fundamental theories and practices. Whenever possible, the exposure factors are reduced to constants, thereby eliminating sources of possible error. The system permits the student to quickly become acquainted with better-than-average quality radiographs that can be produced during the course of instruction. Instruction is in two parts: radiographic exposure and x-ray film processing. (H.G.D.)

22852 I SIMPOSIO ARGENTINO DE MEDICINA NUCLEAR, MENDOZA, 19 AL 21 DE NOVIEMBRE DE 1964. (First Argentine Symposium on Nuclear Medicine, Mendoza, November 19–21, 1964). Buenos Aires, Comision Nazional de Energia Atomica, [1965]. 129p. (CONF-641126).

Summaries are presented of 95 papers on nuclear medicine. Topics discussed include ambient radioactivity, uses of activation analysis in biological studies, use of radioisotopes in cardiology and nephrology, telecobalt therapy, and carcinogenicity. The round table discussions on uses of radioisotopes in endocrinology are summarized. (J.S.R.)

CHEMISTRY

General

22853 (ANL–7060) RADIOLOGICAL PHYSICS DIVISION ANNUAL REPORT, JULY 1964–JUNE 1965. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 140p. Dep. mn. CFSTI $4.00 cy, $1.00 mn.

Research is reported on biphenyl transitions, spectra of aromatic molecules, energy transfer in Ar–N mixtures, gas-phase ion recombination, photo-excitation, isotope effects in photoionization of benzene, isotope effects in ionization, energy transfer effects on luminescence, properties of the generalized oscillator strength, radioinduced osteosarcoma, radiosensitivity of rotifers, beta dosimetry, response of LiF to fast neutrons, LiF neutron image storage, NEUTBAK and RPY 157X programs for cosmic neutrons, ionization of gases by electrons, status of thorotrast-dosed personnel, whole-body counting methods, RPY-139 program for mixtures of gamma-emitters, underground counting facility air measurements, Mössbauer effect from bones, Mössbauer effect in ^{133}Cs, Ra and Sr concentrations in bone, blood, and soft tissue, bone-seeking radioisotopes, ^{226}Ra effects on bones, ^{133}Ba retention by beagles, natural distribution of Th and U, estimation of Th and U in bone, Sr retention by mice, collagen formation and ossification in mice, gamma emission by thorotrast patients, background in low-level gamma facility, multichannel analyzer data processing, multitube preamplifiers, detection of atmospheric ionized columns, ^{222}Rn measurements, air pollution survey instruments, atmospheric vertical heat flux determinations, and instrumentation for atmospheric turbulence studies. (J.R.D.)

22854 (MIT–905-52) CHEMISTRY PROGRESS REPORT, NOVEMBER 1, 1964–DECEMBER 31, 1965. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Dec. 31, 1965. Contract AT(30-1)-905. 101p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Research progress is summarized in four sections. Separate abstracts were prepared for three sections. The section for which no abstract was prepared, briefly summarizes work on determination of vapor-liquid equilibria, electromotive forces in NH_4Br and KBr cells, and diffusion in ion exchanger membranes. (J.R.D.)

For abstracts of individual sections see: 22871, 23044, and 24351.

22855 (ORNL–3913) REACTOR CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1965. (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 160p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

Research and development progress is reported in five parts. Separate abstracts were prepared for each part. (J.R.D.)

For abstracts of individual sections see: 22856, 22857, 23376, 23602, and 23774.

22856 (ORNL–3913, pp 1-51) MOLTEN-SALT REACTORS. (Oak Ridge National Lab., Tenn.).

Research devoted to phase equilibria and crystallography of fluoride salts is summarized along with results of chemical investigations of molten fluorides. Work on chemical separation and irradiation behavior of molten fluorides is reported, and efforts devoted to direct support of MSRE are summarized. (J.R.D.)

22857 (ORNL–3913, pp 111-32) OTHER ORNL PROGRAMS. (Oak Ridge National Lab., Tenn.).

Research work in support of saline water and thermonuclear programs is reported. Investigations of radiation effects on organic materials are described along with studies of fluoride volatility and preparation methods for LiF single crystals. (J.R.D.)

22858 (UCRL–16580) NUCLEAR CHEMISTRY DIVISION ANNUAL REPORT, 1965. Hollander, J. M.; Reynolds, F.; Cunningham, B. B. (eds.) (Lawrence Radiation Lab., Univ. of California, Berkeley). Jan. 1966. Contract W-7405-eng-48. 291p. Dep. mn. CFSTI $6.00 cy, $1.50 mn.

Research and development is reported in eight sections. Separate abstracts were prepared for each section. Abstracts of theses issued by UCRL during 1965 are included. (J.R.D.)

For abstracts of individual sections see: 22859, 23076, 23216, 23217, 23427, and 24358–24360.

22859 (UCRL–16580, pp 149-205) CHEMISTRY. (Lawrence Radiation Lab., Univ. of California, Berkeley).

Research progress is reported on crystal field shielding in rare-earth sulfates; ferromagnetic lattice nuclei hyperfine fields; rare earth ion transitions; three-particle operators for equivalent electrons; prototypes for intra-atomic interactions; magnetic fields at In, Fe, and Ni nuclei; neodymium ethylsulfate thermodynamics below 1°K; $CmCl_3$ crystal structure and heat of formation; curium heat of solution; chemical properties and reactions of Cf; hyperfine fields in Au–Mn compounds; isotope shift study methods; radiation effects on Ge; properties of Am^{+2} in CaF_2 crystals; ^{87}Rb disorientation cross section; structure of Mn complexes; structure of $C_5H_5FeB_9C_2H_{11}$; structure of $Th(NO_3)_4 \cdot 5H_2O$; structure of cycloalliin hydrochloride monohydrate; determination of first ionization potentials; mass spectra of N_2O and NO_2; Dempster-type mass spectrometer ion-peak shapes; and use of semiconductor detectors in x-ray emission spectrography. (J.R.D.)

Analytical Procedures

See also Separation Processes and Procedures

Refer also to abstracts 23236 and 23284.

22860 (AWRE–O–5/66) INVESTIGATION OF FIREARM DISCHARGE RESIDUES. Scott, H. D.; Coleman, R. F.; Cripps, F. H. (Atomic Weapons Research Establishment, Aldermaston (England)). Mar. 1966. 49p. Dep. mn. BIS $4.00. HMSO 20s. 0d.

Using a high speed photographic technique, the manner in which powder residues are deposited on the firing hand was established for a wide variety of firearms. A technique for determining the distribution of residues on the hand was developed and used to investigate the residues deposited by two revolvers, two pistols, a rifle, and a shotgun. Comparisons were made with a swabbing technique and the source of antimony in the residues was investigated. (auth)

22861 (BNL–10130) BIOLOGICAL AND MEDICAL APPLICATIONS OF RADIOACTIVATION ANALYSIS. Borg, Donald C. (Brookhaven National Lab., Upton, N. Y.). Apr. 5, 1966. Contract AT-30-2-GEN-16. 23p. (CONF-660312–2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Nederlands Atoomforum, Utrecht.

Applications of activation analysis in the fields of biology and medicine are reviewed, and aspects of the program at BNL are discussed. One of the most prominent applications of activation analysis to biology has been the measurement of Na, Cl, K, and P in very tiny amounts of tissue. The other major area of application in the life sciences concerns the detection of trace elements, many of which are present in protoplasm in concentrations of less than one ppm. Relative freedom from contamination has made activation analysis more accurate rather than intrinsically more sensitive in biological trace analyses. The method is compared with conventional radiochemical approaches in analyzing for one or a few elements at a time. A bibliography of 51 references is included. (H.G.D.)

22862 (CEA–R–2553) DOSAGE DES PRODUITS DE FISSION DANS LES EFFLUENTS DU TRAITEMENT DES COMBUSTIBLES IRRADIES (METHODE RADIOCHIMIQUE).

(Determination of Fission Products in Irradiated Fuel Treatment Effluents (Radiochemical Method)). Auchapt, Jacqueline M. (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). Feb. 1966. 20p. Dep. mn.

Determination methods applicable to relatively long-lived fission products present in the effluents resulting from irradiated fuel treatment processes (Sr–Cs–Ce–Zr–Nb–Ru–I) are reported. The methods are based on the same principle: addition of a carrying-over agent; chemical separation over several purification stages; determination of the chemical yield by calorimetry; and counting of an aliquot liquid portion. (auth)

22863 (CEA-R-2835) ETUDE DE QUELQUES PROPRIETES DU PHOSPHATE DE ZIRCONIUM [Theses]. (Study of Some Properties of Zirconium Phosphate [Thesis]). Prospert, Jacques (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1966. 62p. Dep. mn.

Submitted to Paris Univ. (France). Faculte des Sciences.

Zirconium phosphate was studied for possible use as an ion-exchanger: the first objective was to develop a reproducible method of preparation. To this end, several tests were carried out varying the molar ratios of phosphorus and of zirconium. Some physical properties such as x-ray diffraction were also examined, along with certain chemical properties, particularly the percentages of free water and structural water given by the loss on calcination, the Karl-Fisher method, and weight loss by thermogravimetry. Finally an attempt was made to apply the exchanger to the separation of alkaline ions. The static tests showed that the order of fixation of these ions was $Cs^+ > Rb^+ \gg K^+ > Na^+$. Tests with columns showed that Na^+ and K^+ were easily separable, as was the $Rb^+–Cs^+$ mixture, the last pair being fairly difficult to dissociate. (auth)

22864 (CEA-R-2914) DOSAGE SPECTROGRAPHIQUE DE PETITES QUANTITES DE BORE DANS LE FER ET LES ACIERS A L'AIDE DU SEPARATEUR D'ORDRES. (Spectrographic Determination of Small Quantities of Boron in Iron and Steels by Means of a Predispersive Spectrometer). Tran Van, Danh; Ernoult, Jacques (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jan. 1966. 15p. Dep. mn.

Small quantities of boron in iron and steels were determined by means of a spectrographic method using a predispersive spectrometer. Samples containing more than 5 ppM of boron can be analyzed with standard deviation of about 10%. (auth)

22865 (CEA-R-2957) DOSAGE DE L'HYDROGENE DANS LE BERYLLIUM. (Determination of Hydrogen in Beryllium). Sannier, Jacques; Leroy, Janine (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1966. 15p. Dep. mn.

A method was developed for determining hydrogen content in beryllium by vacuum extraction at 1150°C in a molten copper bath. Under these conditions, hydrogen evolution is relatively rapid. The results showed that this method has both an excellent sensitivity (on the order of a few parts per million) and good reproducibility. (auth)

22866 (CONF-651214-1) STUDIES ON THE USE OF SALICYLIC ACID AND THE SALICYLATE ION AS LIQUID SCINTILLATORS [Thesis]. Appendix II. Annual Progress Report No. 7. Scott, Charles A. (Louisiana State Univ., New Orleans. Dept. of Chemistry). Jan. 1966. Contract AT(40-1)-2576. 56p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

From American Chemical Society, Southeast-Southwest Regional Meeting, Memphis.

Ionized salicylic acid was found to be an effective single solute in the liquid scintillation counting of ^{241}Am and ^{210}Po. The effect of concentration was studied as well as the quenching effect of methanol, dimethylformamide, and dimethylsulfoxide. The excitation and emission spectrum were found to be in the region of S-11 response. Although methanol and dimethylformamide were found to quench the scintillator output, they still proved useful in enhancing the dissolution of aqueous samples. Solvent extraction with subsequent determination of the distribution of ^{241}Am by liquid scintillation counting of the alpha activity was performed with good results. (auth)

22867 (INR-619/XV/E) SPEKTROMETR ECHA SPINOWEGO. (Spin Echo Spectrometer). Antoniak, W.; Chmielewski, J. (Institute of Nuclear Research, Warsaw (Poland)). 1965. 37p. Dep.

A Nuclear Magnetic Resonance Spectrometer based on Spin Echo technique is used here for studies on possibilities of moisture measurements in different solid substances. The spectrometer consists of the following principal units: electromagnet measuring head with crossed coils, preamplifier, r-f amplifier, pulse voltmeter, pulse transmitter, pulse pair generator and auxiliary units such as power supply etc. Electromagnet with 30 mm gap between poles 150 mm diameter has approximate field strength of about 2300 Oe. Measuring head accepts standard glass probes with external diameter of 13 mm which corresponds to sensitive volume of about 3 ccm. Normal operating frequency is 10 MHz. Noise level of receiving system including measuring head corresponds to 0.3 μv. Echo pulse amplitude is measured on peak voltmeter with long time constant. Pulse pair generator delivers two pulses, first being 20 μsec width and the second 40 μsec. Delay time of the second pulse may be varied from 100 μsec to 300 msec. Spectrometer as a whole consists of two items: an electromagnet placed on a cart and a standard rack containing 3 mounting panels with individual plug-in units for particular circuits. Some results of measurements of moisture in several substances and corresponding relaxation times are included. (auth)

22868 (JUL-347-PC) BESTIMMUNG DER SPEZIFISCHEN α-AKTIVITAET DES ^{239}Pu MIT HILFE EINER FLUESSIG-SZINTILLATIONSZAEHLMETHODE. (Determination of Specific α Activity of ^{239}Pu with the Help of a Liquid Scintillation Counter Method). Ihle, H. R.; Karayannis, M.; Murrenhoff, A. P. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie). Jan. 1966. 36p. Dep. mn.

By using an improved liquid scintillation counting method, the specific α-activity of Pu-239 was determined to be 136400 ± 360 dpm^{-1}/ug^{-1}, which corresponds to a half life of 24350 ± 63 years. The counting method used has considerable advantages over other methods for the precise determination of specific activities of α-emitters. However, the possibilities of discriminating against β/γ-emitting impurities are limited. (auth)

22869 (LA-3468) SEPARATION AND SPECTROPHOTOMETRIC MEASUREMENT OF 0.5 TO 10 PARTS PER MILLION OF THORIUM IN PLUTONIUM. Bryan, R. G.; Waterbury, G. R. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Feb. 1, 1966. Contract W-7405-eng-36. 19p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Trace concentrations (0.5 to 10 ppM) of thorium in plutonium were measured spectrophotometrically as the Arsenazo III complex, following separation by a two-step precipitation-anion exchange resin method. In the first separation step, plutonium is oxidized to the (VI) oxidation state in fuming perchloric acid, and the thorium, with lanthanum carrier, is precipitated as the fluoride while the plutonium (VI) remains in solution. In the second step, the precipitate is dissolved in 7.8 N nitric acid and passed through an anion exchange resin column which adsorbs only the thorium and remaining traces of plutonium. The thorium is eluted selectively with 12 N hydrochloric acid, and the thorium-Arsenazo III complex is formed in 4 N perchloric acid. At a wavelength of 665 mμ, the molar absorptivity of the complex is 113,000. Relative standard deviations calculated from 12 or more determinations each of 0.5, 2, 3, 5, and 10 μg of thorium added to 1-gram samples of plutonium are 4.7, 3.7, 3.9, 2.3, and 2.2%, respectively. Of 45 other elements investigated, only Al, Sb, Ca, La, Mo, Sn, and W cause interference when present in 100-mg quantities. Of these

interfering elements, only antimony interferes when the quantity is reduced to 10 mg. (auth)

22870 (LA-DC-7625) A METHOD OF ASSAY OF ^{235}U, ^{238}U, AND ^{237}Np FISSION FOILS. Smith, H. L.; Balagna, J. P. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1966]. Contract W-7405-eng-36. 16p. (CONF-66303-23). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

A combination of 2π and low geometry α counting was used to assay a set of vacuum-evaporated ^{235}U, ^{238}U, and ^{237}Np foils to be used in the measurement of their relative high-energy neutron fission cross sections. The masses assigned to the uranium foils rest on experimentally determined specific α activities; the neptunium masses depend on low geometry counting and the published half-life. (auth)

22871 (MIT-905-52, pp 42-73) INSTRUMENTAL CHEMISTRY GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Investigations of problems grouped under the general heading of electroanalytical chemistry are summarized. Other investigations in the areas of luminescence, plasma spectroscopy, vapor-liquid equilibria, and computer interpretation of spectra are also reported. (J.R.D.)

22872 (NIRS-4, pp 12-17) PHYSICAL SCIENCES: CHEMISTRY. (National Inst. of Radiological Sciences, Chiba (Japan)).

Progress is reported on studies of the reaction of excited singlet oxygen atoms with propane; the rapid separation of ^{137}Cs, ^{144}Ce, ^{85}Sr, ^{95}Zr, ^{59}Fe, and ^{60}Co by thin layer chromatography using a silica gel-TTT (2-thenoyltrifluoroacetone) plate; the development of a radiochemical method using an ion exchange technique for the determination of ^{137}Cs and ^{90}Sr in fallout deposits and other environmental substances; spectroscopic studies of AET and AET derivatives; electronic absorption studies on vitamin B_6 related substances; the development of an ion exchange method for the concentration of ^{144}Ce, ^{95}Zr, ^{106}Ru, ^{90}Sr, and ^{137}Cs from seawater; and the development of an ion exchange separation-flame photometric method for the determination of Sr in bone. (C.H.)

22873 (ORNL-TM-1480) THE EXTRACTION OF TRIVALENT GOLD FROM HYDROCHLORIC ACID SOLUTIONS INTO ISOPROPYL ETHER, BIS-(β-CHLOROETHYL) ETHER, ETHYL ACETATE, AMYL ACETATE, AND METHYL ISOBUTYL KETONE. Pinajian, J. J. (Oak Ridge National Lab., Tenn.). Apr. 1966. Contract W-7405-eng-26. 9p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The extraction of trivalent gold by isopropyl ether, bis-(β-chloroethyl) ether, ethyl acetate, amyl acetate, and methyl isobutyl ketone from hydrochloric acid solutions was studied as a function of acid concentration. The distribution coefficients were found to decrease in the order: amyl acetate < isopropyl ether < ethyl acetate < bis-(β-chloroethyl) ether < methyl isobutyl ketone. Isopropyl ether and ethyl acetate were found to be soluble in higher concentrations of hydrochloric acid solutions. Bis-(β-chloroethyl) ether had a distribution coefficient reaching a maximum of 495 at 6M HCl. Methyl isobutyl ketone had a distribution coefficient of 1098 at 6M HCl which increased to ~6000 at 1M HCl. The distribution coefficient of platinum was found to be $\sim 10^{-2}$ at 6M HCl and factors for separation from gold were estimated to be 5×10^4, 5×10^3, and 6×10^5 for isopropyl ether, bis-(β-chloroethyl) ether, and methyl isobutyl ketone, respectively. (auth)

22874 (ORNL-TM-1481) THE METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE) EXTRACTION OF TRIVALENT IRON FROM HYDROCHLORIC ACID SOLUTIONS AND THE EFFECT OF AN INERT DILUENT ON THE DISTRIBUTION COEFFICIENT. Pinajian, J. J. (Oak Ridge National Lab., Tenn.). Apr. 1966. Contract W-7405-eng-26. 9p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The methyl isobutyl ketone extraction of iron(III) chloride from hydrochloric acid solutions was investigated as a function of the iron concentration and the hydrochloric acid concentration. Values of the K_D are given for 0.01-5M Fe^{3+} and 0.01-8M HCl. The K_D increases with an increase in hydrochloric acid concentration and decreases only slightly with an increase in iron concentration. In 6M HCl there is little effect on the K_D from the addition of an inert diluent, up to a concentration of 2M n-hexane, at which point the K_D rapidly decreases from 1.1×10^3 to 2.4×10^{-2} at 6M n-hexane. The distribution coefficients were determined for carrier-free ^{54}Mn and ^{55}Co for the 6M HCl system and their factors for the separation from iron are estimated to be 10^7 and 10^6, respectively. (auth)

22875 (ORO-2670-10) THE NON-DESTRUCTIVE DETERMINATION OF SILICON AND OXYGEN IN METEORITES BY FAST NEUTRON ACTIVATION ANALYSIS [Thesis]. Vogt, James R. (Kentucky Univ., Lexington. Dept. of Chemistry). Apr. 1, 1966. Contract AT(40-1)-2670. 165p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

The development of a highly automated system for rapid and precise fast neutron activation analysis, and its application to the non-destructive determination of silicon and oxygen in a wide variety of stony meteorites is described. An automated pneumatic tube sample transfer system was constructed that permits samples to be sent 200 feet—from a 250 kv Cockcroft-Walton accelerator to a counting room—in less than four seconds. Two solenoid operated pneumatic sample spinner assemblies were built to permit rotation of the samples during irradiation and counting. A solenoid operated beam-stop assembly was developed that permits turning the neutron beam on and off in a time interval on the order of milliseconds. An irradiation control system was designed that permits automatic control of all irradiation and counting processes, and a computer program was developed for automatic processing of the data. Techniques were developed for the non-destructive determination of silicon and oxygen in stony meteorites, and a total of 884 individual analyses were made. An IBM-1410 computer was used to normalize the data for variations in neutron flux, irradiation time, delay time, and dead time. Following normalization the computer calculates an average standard comparator factor from data obtained by irradiation of standards of the element to be determined. Usually one standard sample is run for every 10-20 analyses. The comparator factor is then used to calculate the weight and percent of the element to be determined in each of the samples using the normalized data from the irradiation of the samples. Data are tabulated. (P.C.H.)

22876 (RFP-644) EVALUATION OF DIRECT READING ATTACHMENT FOR EMISSION SPECTROGRAPH. Barton, H. N.; Vejvoda, E. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). Apr. 21, 1966. Contract AT(29-1)-1106. 43p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A photoelectric recording (direct reading) attachment for a 3.4-meter Ebert emission spectrograph is described and evaluated. Relationships and constants describing excitation, photographic recording, photoelectric recording, and optical alignment were determined. Impurity analysis of PuO_2 and U_3O_8 with direct reading by a carrier distillation method is also described. (auth)

22877 (TID-22846) ABSORPTIOMETRY WITH BETA-EXCITED X-RAY SOURCES. An Interim Report. Preuss, Luther E.; Kann, J. A.; Bugenis, C. K. (Edsel B. Ford Institute for Medical Research, Detroit, Mich. Physics Dept.). [nd]. Contract AT(11-1)-1239. 23p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The applicability of beta-excited x-ray sources in substitution for the conventional x-ray machine in x-ray absorption analysis was studied. It was proposed that beta-excited x-ray sources of ^{147}Pm with Cu, Fe, and Mo targets be tested as possible sources of x-ray photons for absorptiometry. Preliminary studies showed that the beta-excited x-ray sources exhibit some promise in absorptiometry with certain solvent-solute combinations. These sources produce characteristic x-rays as well as the bremsstrahlung continuum, and the application herein necessarily involves polychromatic absorptiometry. Cer-

tain factors of economy, small size, and stability are advantages of the beta excited x-ray source. The low x-ray intensity is not a serious problem in this application and reproducible, standard absorption curves may be obtained from relatively low activity samples. Standard deviations of one to two percent are possible in most determinations. The results also indicate that beta-excited source types other than the three above may profitably be used in absorptiometry. (P.C.H.)

22878 (TRG-Report-1185) THE ANALYSIS OF CARBON IN SODIUM. Sinclair, V. M.; Drummond, J. L.; Smith, A. W. (Reactor Group, United Kingdom Atomic Energy Authority, Dounreay (Scotland)). Feb. 1, 1966. 11p. (CONF-651004-14). Dep. BIS $0.40. HMSO 2s.

From 9th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn.

The reactions of various carbon-containing compounds that could be present in sodium were studied, to see whether a method of measuring total carbon by distillation of the sodium under reduced pressure and the subsequent measurement of the carbon in the residue by combustion techniques is sound and capable of measuring the total carbon. The source of blank levels of carbon in the distillation procedure was examined. Methods for determining possible carbon-containing species in sodium, e.g., carbonate, carbide, carbonyl and free carbon, were also examined, and some reactions involving these species were studied. (P.C.H.)

22879 (AEC-tr-6466/1, pp 260-7) RADIOACTIVITY-BASED METHODS OF DETERMINING MICROIMPURITIES IN MATERIALS USED IN SEMICONDUCTOR PRODUCTION. Rychkov, R. S.; Berkutova, I. D.; Glukhareva, N. A.; Gofman, A. K.; Kuznetsova, G. A.; Smirnova, N. B. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Methods of activation analysis involving both the measurement of beta activity and gamma activity are discussed with specific consideration of their use in the determination of microimpurities in materials used in the production of semiconductors. (D.C.W.)

22880 (AEC-tr-6466/1, pp 272-7) THE USE OF ^{147}Pm IN A HIGH-SENSITIVITY IONIZATION GAS ANALYZER. Oziraner, S. N.; Gaziev, G. A.; Yanovskii, M. I.; Kornyakov, V. S.; Kapshaninov, Yu. I. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A high-sensitivity ionization gas analyzer that uses promethium-147 beta-activity source is described. Some tests of the gas analyzer with a chromatographic installation are discussed. (G.O.Y.)

22881 (AEC-tr-6466/1, pp 288-92) MEASUREMENT OF SMALL AMOUNTS OF IMPURITIES IN THALLIUM, GALLIUM, PHOSPHORUS, AND ANTIMONY BY RADIOACTIVATION ANALYSIS. Alimarin, I. P.; Yakovlev, Yu. V.; Shchulepnikov, M. N.; Perezhogin, G. P. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Samples of Sb, Ga, P, and Tl were analyzed for trace elements using radiochemical separation in the case of Sb and Ga and gamma spectrometry in the case of P and Tl. The results show that both techniques can be used for the activation analysis of very pure materials, the appropriate method depending on the properties of the material. (D.C.W.)

22882 SEPARATION OF CRYSTALLINE VITAMIN D_3 FROM THE IRRADIATED SOLUTION OF 7-DEHYDROCHOLESTEROL. Jaworska, R.; Salwa, H. (Pharmaceutical Inst., Warsaw). Acta Polon. Pharm., 20: 386-7 (1963).

Crystalline vitamin D_3 was obtained, after uv irradiation of the provitamin, by the chromatographic separation of the crystalline complex of vitamin D_3 with cholesterol on an Al_2O_3 column. This adduct was easily and directly prepared from the mixture obtained through irradiation of 7-dehydrocholesterol. A mixture produced by uv irradiation of the benzene solution of 7-dehydrocholesterol, with a low-pressure quartz-lamp yielded a crystalline complex of vitamin D_3 with cholesterol, containing about 45% of vitamin D_3 which was dissolved in a small amount of benzene dried over sodium. The solution was poured on a column containing 50 g Al_2O_3 in a tube of 2 cm dia and eluted with pure benzene. The presence of vitamin D_3 in the effluent was checked with Nield's reagent and that of cholesterol with digitonin solution. After the first portion of ~100 ml of eluent was discarded, the next 120 ml was collected as fraction I containing 450 mg of pure vitamin D_3 (85% of the entire amount present). Fraction II, consisting of 120 ml of eluent, contained 48 mg of vitamin D_3 and 30 mg of cholesterol. Benzene with acetone (4 : 1) was then used as eluent and fraction III (150 ml) containing pure cholesterol and fraction IV (80 ml) containing impure cholesterol were collected. Fraction I was stripped of the solvent, the dry residue dissolved in acetone and, after crystallization, 320 mg of crystalline vitamin D_3 was obtained. The yield of crystalline vitamin D_3 calculated on the amount of 7-dehydrocholesterol used was 20%, an additional 5% being obtained in the form of pure adduct. (BBB)

22883 NUCLEONICS. Lyon, W. S.; Ross, H. H. (Oak Ridge National Lab., Tenn.). Anal. Chem., 38: No. 5, 251R-61R(Apr. 1966). (ORNL-P-1938).

Developments in nucleonics for the period Oct. 1963 to Oct. 1965 are reviewed. The topics discussed include: radiochemistry; nuclear methods, Moessbauer analysis; liquid scintillation counting; radio-reagent methods; radiometric methods; activation analysis; instrumentation for nuclear measurement; computer applications; absolute measurement of radioactivity; and burnup measurement. (325 references). (P.C.H.)

22884 MOESSBAUER SPECTROMETRY. DeVoe, J. R.; Spikerman, J. J. (National Bureau of Standards, Washington, D. C.). Anal. Chem., 38: No. 5, 382R-93R (Apr. 1966).

A review of the applications of Moessbauer spectrometry to chemical analysis, and a bibliography of publications on these applications in 1965 is presented. The principle of the spectrometer as well as a discussion of errors associated with its use are described. Current theoretical interpretations of some aspects of the Moessbauer spectrum are discussed. 160 references are cited. (P.C.H.)

22885 X-RAY ABSORPTION AND EMISSION. Campbell, William J.; Brown, James D.; Thatcher, John W. (Bureau of Mines, College Park, Md.). Anal. Chem., 38: No. 5, 416R-39R(Apr. 1966).

A critical review of fundamental developments and tabular summaries of applications of x-ray spectrography and electron probe microanalysis is presented. 637 references are cited. (P.C.H.)

22886 THE DETERMINATION OF STABLE SCANDIUM IN PLANTS, ANIMALS, SEDIMENTS, SANDS, SOILS, ROCKS AND MINERALS BY NEUTRON-ACTIVATION ANALYSIS. Miro, M.; De Padovani, I. Oliver; Ramos, E.; De Vega, V. Roman; Lowman, F. G. (Puerto Rico Nuclear Center, Mayaguez). Anal. Chim. Acta, 35: 54-60(1966).

A method is described for determination of stable scandium in samples of plants, animals, sediments, soils, rocks, and minerals. The samples and comparator standards were irradiated in a neutron flux of 5×10^{12}n/cm^2/sec for 4 hr and dissolved. The scandium was quantitatively precipitated from 2N nitric acid as scandium phytate; contaminants were rinsed from the precipitate with nitric and hydrochloric acids. The limit of detection was 0.005 μg (±10% at the 95% confidence level). The activated ^{46}Sc was counted by γ spectrometry. (auth)

22887 ACTIVATION ANALYSIS OF MERCURY IN HIGH-PURITY BISMUTH. Kim, J. I.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 35: 61-8(May 1966).

A neutron activation method was developed for the determination of traces of mercury in high-purity bismuth. After neutron irradiation at a flux of approx. 4×10^{11}n/cm^2/sec, mercury was separated from the matrix by displacement on metallic copper and subsequent distillation and amalgamation on silver foil. The γ activity of the ^{197}Hg was counted

in the 68 to 77 kev region. The accuracy of the procedure was tested by an addition method of analysis. Bismuth samples with a mercury content in the 10 ppB region were analyzed. (auth)

22888 NEUTRON-ACTIVATION ANALYSIS BY STANDARD ADDITION AND SOLVENT EXTRACTION. **Alian, A.; Parthasarathy, R. (Atomic Energy Establishment, Trombay). Anal. Chim. Acta, 35: 69-73 (May 1966).**

In an approach to activation analysis chemical yield determinations are avoided by selective extraction of the required element in conjunction with the standard addition technique. The principle and its application to the determination of traces of uranium in aluminum and the standard granite (G-1) are given. The advantages of this method are its simplicity and rapidity. (auth)

22889 USE OF LITHIUM-DRIFTED GERMANIUM DIODES FOR THE γ-SPECTROMETRIC DETERMINATION OF RADIOACTIVE FISSION-PRODUCT NUCLIDES. Banham, M. F.; Fudge, A. J.; Howes, J. H. (United Kingdom Atomic Energy Research Establishment, Harwell, Eng.). Analyst, 91: 180-8(Mar. 1966). (AERE-M-1606).

The superiority of a γ spectrometer with a germanium-lithium diode detector and field-effect transistor head amplifier over the conventional sodium iodide–thallium system, for resolution of most of the difficult determinations encountered in fission-product radiochemistry, is demonstrated. (auth)

22890 SIMULTANEOUS DETERMINATION OF IODINE AND BROMINE IN URINE BY NEUTRON ACTIVATION ANALYSIS. Belkas, E. P.; Souliotis, A. G. (Nuclear Research Centre Democritus, Athens). Analyst, 91: 199-204(Mar. 1966).

Neutron-activation analysis was used for the simultaneous determination of iodine and bromine in urine. The activated iodine and bromine were separated by radiochemical methods. The 0.46- and 0.55-Mev peak areas of ^{128}I and ^{82}Br, respectively, were measured by means of a multichannel analyzer. The amounts of iodine and bromine were found to be of the order of 10^{-7} and 10^{-6} g ml^{-1} of urine, respectively, for normal human beings of different ages. (auth)

22891 AUTOMATIC DETERMINATION OF THORIA IN THORIA-URANIA MIXTURES. Stuart, W. A. (Atomic Energy Research Establishment, Harwell, Eng.). Analyst, 91: 208-10(Mar. 1966).

Determination of the thoria content of thoria-urania samples using an autoanalyzer is described. The interference of fluoride and uranium is discussed. The reproducibility of the autoanalyzer method for one solution was found by feeding 10 aliquots through the system. A coefficient of variation greater than 2% was found. The automatic method is capable of producing 20 analyses per hour. (F.J.H.)

22892 DETERMINATION OF FLUORINE BY NEUTRON ACTIVATION. Bakes, J. M.; Jeffery, P. G. (Warren Spring Lab., Stevenage, Eng.). Analyst, 91: 216-17 (Mar. 1966).

Determination of fluorine by neutron activation was studied as a means of easily and rapidly examining large numbers of mill products containing fluorite. Four separate neutron-induced reactions can be used to determine fluorine. The fluorine contents were calculated by using a sample of pure crystalline fluorite as reference material. The results are shown in comparison with results obtained with a pyrohydrolysis technique. (F.J.H.)

22893 ON THE DETERMINATION OF DEUTERIUM BY PHOTODISSOCIATION. **Lazzarini, Ennio; Terrani, Mario (Centro Studi Nucleari Enrico Fermi, Milan). Ann. Chim. (Rome), 55: 1014-27(Oct. 1965). (In Italian).**

The method for determination of D by photodissociation, previously studied for H_2O, was extended to other compounds, chiefly organic. The effect of scattering and macroscopic cross sections for absorption on the detection efficiency for thermal neutrons was studied. With the formula developed for these factors, samples of equal volume containing D ranging from 150 ppm to 10.53 at. % were analyzed; results generally had 1 to 5% relative error over this range and had high accuracy. Samples with very high D content must be corrected for diminished macroscopic cross section for diffusion and absorption because of their lower ^{1}H content. Samples of water and ethyl alcohol containing about ten moles of hydrogen were examined. Four determinations were made and variance, standard deviation, and Student t test applied; assuming the concentration of D in the H of H_2O is 150 ppM, the concentration of D in the H of ethyl alcohol of fermentation was found to be 119 ± 5 ppM. Similar measurements on water and benzene indicated no significant difference. (BBB)

22894 ANALYTICAL CHEMISTRY. **Headridge, J. B. (Univ. of Sheffield, Eng.); Pierce, T. B.; Anderson, D. M. W. Ann. Rep. Progr. Chem., Chem. Soc. London, 61: 527-66(1964).**

Developments in radiochemistry and mass spectroscopy are reviewed. Extensive use was made of tracer methods to examine the behavior of two-phase systems and to develop separation procedures. Liquid scintillation counting was the subject of much research. A balanced quenching technique was recommended for the determination of ^{14}C, and low levels of ^{14}C were counted after incorporation in methyl benzoate. Statistical aspects of counting two isotopes by liquid scintillation were considered and the method proposed for quenching correction of samples labeled with both ^{14}C and ^{3}H was extrapolated. The relatively high solubility of krypton, xenon, and radon in hydrocarbons employed as solvents for liquid scintillators permits liquid scintillation techniques to be used to determine the activity of isotopes of these gases. Short-lived nuclides with half-lives varying from 2.7 msec to 20 min produced in activation procedures were tabulated, and cross sections for (n,α) reactions with 14-Mev neutrons listed. A computer program to optimize irradiation and decay times in instrumental activation analysis was developed. Activation analysis was extensively applied to the determination of trace elements in biological materials. The mass spectroscope was used by several investigators in conjunction with gas chromatography. Application of mass spectroscopy to inorganic and organic analyses is discussed. Mass spectrometry in conjunction with isotope dilution forms a useful technique. Atmospheric pollution was studied by mass spectrometry. A system of vaporizing samples directly in the ion-source of any type of mass spectrometer was devised and this should extend the applicability of the method. The storage of large numbers of mass spectra on magnetic tape, with retrieval by digital computer, was proposed. (BBB)

22895 SUPPRESSION OF SELECTIVE VOLATILIZATION IN A METHOD FOR THE SPECTROGRAPHIC ANALYSIS OF LANTHANUM. **Whitehead, A. B.; Piper, B. C.; Heady, H. H. (Bureau of Mines, Reno, Nev.). Appl. Spectros., 20: 107-12(Mar.-Apr. 1966).**

The effects of electrode type, arc current, and the Stallwood Jet on selective distillation of impurities other than rare earths in La_2O_3 were evaluated. Selective volatilization was reduced by use of a 20-amp d-c arc with a $\frac{1}{8}$-in-diam electrode. An analytical method incorporating these operating conditions is presented for 19 impurity elements in La_2O_3 prepared from the lanthanum metal sample. The overall precision was about ±14% relative standard deviation over the concentration range of 30 to 1000 ppM. (auth)

22896 DETERMINATION OF IMPURITIES IN ALUMINIUM BY MEANS OF ACTIVATION ANALYSIS. **Kiesl, W.; Sorantin, H.; Bildstein, H. (Reaktorzentrum, Seibersdorf, Austria). Atompraxis, 12: 130-5(Mar. 1966). (In German).**

Literature was surveyed on the use of activation analysis to determine impurities in aluminum. An analytic procedure used for quantitative determination of dysprosium, gallium, vanadium, nickel, manganese, copper, antimony, tin, scandium, hafnium, chromium, cobalt, iron, zinc, and indium is described. It was found that if aluminum of the highest purity is used in reactor technology, special attention must be paid to the impurities resulting from scandium, antimony, and cobalt. (auth)

22897 α-SPECTROMETRIC DETERMINATION OF THE U/Th RATIO IN MINERALS OF PEGMATITIC ORIGIN. Gazzoni, Giuseppe; Rigault, Germano (Univ., Turin. Consiglio Nazionale delle Ricerche, Turin). Atti Accad. Sci. Torino: I. Cl. Sci. Fis., Mat. Natur., 100: 79-90(1965-66). (In Italian).

A method for the determination of uranium and thorium using α spectrometry is described. Sensitivity limits were established. The method was then applied to the determination of the ratio U/Th in minerals of pegmatitic origin. (tr-auth)

22898 CONCENTRATION DETERMINATION BY LIGHT ATTENUATION METHOD. **Kondic, Nenad. Bull. Boris Kidrich Inst. Nucl. Sci., 16: 207-22(Oct. 1965).**

Because of the simultaneous scattering and absorption during transition of nearly monochromatic light through a dispersion of nonuniform particles in a transparent fluid, the method of light attenuation can be used for concentration determination. The logarithm of the quotient of the photomultiplier output with and without particles in the light beam is directly proportional to the mass concentration of particles and inversely proportional to the mean optical diameter of spectrum particles. The optical diameter is the diameter of a particle for which the volume/surface area ratio is the same for the whole spectrum. The attenuation coefficient for a sufficiently large value of the group 4 is a constant independent of the spectrum shape. In experiments with droplets obtained by condensation in a vapor–air mixture parallel measurements of concentration based on purely thermal quantities showed that the linear function was within ±5%. (auth)

22899 SEPARATION OF AMERICIUM FROM PLUTONIUM BY ANION EXCHANGE. **Cvjeticanin, Dane; Ratkovic, Slobodan. Bull. Boris Kidrich Inst. Nucl. Sci., 16: 223-31(Oct. 1965).**

A method for the separation of Am^{3+} from Pu^{4+} by anion exchange on Dowex 1-X4 at 50°C is described. The procedure allows quantitative separation of small amounts of americium from plutonium in one run. The method was used for the determination of ^{241}Am, ^{241}Pu (by measuring the alpha activity of ^{241}Am built-up from ^{241}Pu), and ^{238}Pu in plutonium samples, using alpha spectrometry. (auth)

22900 ISOTOPE ANALYSIS OF URANIUM SAMPLES BY ALPHA SPECTROMETRY. Cvjeticanin, Dane; Bulovic, Vlastimir; Zmbov, Kiro. Bull. Boris Kidrich Inst. Nucl. Sci., 16: 233-44(Oct. 1965).

The isotopic ratios $^{234}U/^{238}U$ and $^{235}U/^{238}U$ in depleted, natural, and slightly enriched (up to 2 wt % ^{235}U) uranium samples were determined by alpha spectrometry using a Frisch-type ionization chamber. The results were compared with the ^{235}U content obtained by mass spectrometry. The alpha activity ratios $^{234}U/^{238}U$ and $^{235}U/^{238}U$ in the samples investigated were within (0.163 ± 0.005) to (2.98 ± 0.02) and (0.018 ± 0.002) to (0.125 ± 0.002), respectively. Data for the samples showed a definite dependence of the $^{234}U/^{235}U$ isotopic ratio on the ^{235}U content. (auth)

22901 USE OF ACTIVATION ANALYSIS FOR AGRICULTURAL PRODUCTS AND FOODSTUFFS. **Fourcy, A. (CEN, Grenoble, France). Bull. Inform. Sci. Tech. (Paris), No. 99, 57-70(Dec. 1965). (In French).**

Some radiations, among which the more commonly used are thermal neutrons, have the property of inducing radioisotopes from the stable elements of the irradiated sample. If this property is carefully avoided in large irradiations of foods for conservation, it allows, on an other hand, interesting uses in qualitative and quantitative analysis of foodstuffs and agricultural products. Among potential uses, let us indicate: the precise determination of trace elements in plants for diagnosis of their growing environment, the control of the mineral component of feeds, the efficacity studies of pesticides, the analysis of pesticide residues, the identification of plant samples by gamma spectrometry. (auth)

22902 ALPHA SPECTROSCOPY OF ^{239}Pu PRESENT IN IMPOVERISHED URANIUM FROM PREPARATIONS OBTAINED BY ELECTROLYTIC CODEPOSITION. **Rollier, M. A.; Maxia, V.; Meloni, S. (Univ. Pavia, Italy). Chim. Ind. (Milan), 47: 183(Feb. 1965). (In Italian).**

In the range of concentration of Pu in U from 0.8 to 0.1 ppM, the determination of Pu in U by codeposition and alpha spectroscopy carries an error of about 20%. Data presented in 1962 (Chim. Ind. (Milan), 44: 1125 (1962)) at the Ninth National Congress of Chemistry in Naples must take this range into account. The good agreement with theoretical prediction for the amount of Pu produced by irradiation for about 1000 hr of a subcritical mass is shown to be incorrect. The value calculated is said to be in error by a factor of 10^4 at least; it exceeds the possible yield by that figure and is due to a calculation error. The quantity of Pu found in a sample of impoverished U immediately after irradiation should be 0.5 ± 0.1 ppM (BBB)

22903 INVESTIGATION OF THE ACCURACY OF THE DROP METHOD ANALYSIS OF HEAVY WATER HAVING A LOW CONCENTRATION OF DEUTERIUM. **Wei, Chung-Wu; Liu, Tien-ch'iu. Ch'ing Hua Ta Hsueh Hsueh Pao, 11: 61-71(1964).**

The regularity of drop movement in the tube was investigated by analyzing heavy water by means of the drop method. It was found that the drop movement diverges considerably from Stokes' Law as the ratio of the drop radius to the tube radius (r/R) increases. The maximum rate of fall of the drops may be determined. Experiments showed that in an o-fluorotoluene medium the value of r/R corresponding to the maximum rate of fall equals 0.43 to 0.44. This value did not depend on the tube radius or the density of the sample. A formula is proposed for determination of the drop movement in the tube. At the maximum velocity the error of measurement due to nonuniformity of drop dimensions considerably decreased. Thus, the errors caused by variations in room temperature, the effect of final fluidity, and inaccuracy in reading the dimensions decreased. Accuracy of the given method in heavy water analysis with concentrations of D_2 < 0.4 mole % D_2O attained ±1 r. The effects of temperature, pressure, and other parameters on the results of analysis were determined and factors influencing the stability of the medium were investigated. (CFSTI)

22904 INVESTIGATION OF THE ACCURACY OF DROP-METHOD ASSAY OF HEAVY WATER WITH A LOW CONCENTRATION OF DEUTERIUM. II. INVESTIGATION OF THE MOVEMENT OF LARGE DROPS. **Lo, Ch'i-fang; Liu, Tien-ch'iu. Ch'ing Hua Ta Hsueh Hsueh Pao, 11: 73-80(1964).**

A study was made of the accuracy of the analysis of heavy water with a low concentration of D_2 with the aid of large drops, with a radius of ~0.32 cm, and a volume of 150 μl. On analysis of heavy water in the interval of 0.015 to 0.1 mol % D_2O the accuracy increased to ±0.2γ. The sensitivity of the analysis also increased three times. It was found that the pattern of the movement of large drops in a test tube does not differ from that of the normal ones. Their maximum fall rate was also obtained. The length of the uniform speed segment and the head effect were determined. The measurement should be performed after the drop starts passing 6 cm from the surface of the medium. It was found that in the lower section of the test tube the head effect is absent. (CFSTI)

22905 BROMOPYROGALLOL RED AS COLORIMETRIC REAGENT. III. PHOTOMETRIC DETERMINATION OF LANTHANUM. **Suk, V. (Karlsun Univ., Prague). Collect. Czech. Chem. Commun., 31: 367-70(Jan. 1966). (In German).**

On the basis of the study of optimum conditions for the colorimetric determination of lanthanum with bromopyrogallol red, a sensitive method for the photometric determination of lanthanum was developed. The method described made possible a direct and simple determination of lanthanum in solution with concentrations of 0.05 to 3.0 μg/ml. (tr-auth)

22906 RADIOCHEMICAL DETERMINATION OF ^{90}Sr IN WEAKLY ACTIVE SAMPLES. **Zaidman, S. Ya.; Pogodin, R. I. Gig. Sanit., No. 1, 61-3(Jan. 1966). (In Russian).**

In order to overcome the difficulties encountered in the separation of ^{90}Sr from Ca, a method was developed for determining the concentration of ^{90}Sr in animal or vegetable samples which may contain as much as 400 to 500 mg of Ca, in addition to P, K, Na, and Mg, while exhibiting a low β activity. The calcined samples were treated with aqua regia to remove the Ca and Sr by precipitation with sulfuric acid. The sulfates were transformed into carbonates, which were dissolved in nitric acid and the Ca extracted from the nitrate solution by repeated treatments with acetone. The ^{90}Y daughter was precipitated on ferric hydroxide and was determined, after standing for about 12 to 14 days, on the basis of its β activity. The method was found to be useful for determining the ^{90}Sr content of low-activity samples containing large quantities of extraneous matter. (TTT)

22907 DETERMINATION OF ALDOSTERONE BY DOUBLE ISOTOPE DILUTION DERIVATIVE METHOD. Kono, Takeshi; Yoshimi, Teruia; Yamada, Shigeki (Kyoto Univ.). Hormon To Rinsho, 11: 481-6(1963). (In Japanese).

The daily urinary secretion rate of aldosterone was determined by a double isotope dilution derivative method, which is described. ^{3}H-aldosterone was injected intravenously. A 24-hr urine sample was adjusted to pH 5 and 500,000 units of β-glucuronidase was added and hydrolysis allowed to proceed at 37°C for 5 days. An ethyl acetate extract of the sample was then washed with 0.1N NaOH and with water, and was dried. The residue was resolved by paper chromatography using an ethylene dichloride-formamide system at 25°C for 48 hr. Tetrahydroaldosterone was acetylated with ^{14}C-acetic anhydride to form $^{3}H,^{14}C$ double-labeled tetrahydroaldosterone triacetate. The product was purified by paper chromatography at 25°C for 18 hr, then purified further by partition column chromatography. The eluent was separated by an automatic fraction collector in 5-ml fractions. The fraction with a constant $^{3}H/^{14}C$ ratio was obtained in the 10 to 20th tubes. The amount of tetrahydroaldosterone was measured on the basis of the amount of ^{14}C and the specific activity of ^{14}C-acetic anhydride used for tetrahydroaldosterone labeling. Similarly, the amount of tetrahydroaldosterone measured on the basis of ^{3}H was obtained. From these values, the daily secretion rate of aldosterone could be determined. The daily secretion rate determined for normal men by this method was 150 to 330 μg/day (average 200 μg/day). (BBB)

22908 ION EXCHANGE SEPARATION OF RUBIDIUM AND CESIUM. I. USING NITRIC ACID–BUTANOL AND ANION EXCHANGE RESIN. Sun, I-liang; Lu, Lan-chiang (Peking Univ.). Hua Hsueh Hsueh Pao, 30: 117-20(1964).

The anion exchange action and method for separating Rb and Cs in nitric acid-alcohol mixture are described. Nitric acid based zeolite FF (200-400 sieve) was used as the anion exchange resin. Radioisotopes ^{137}Cs and ^{86}Rb which were purified to remove ^{35}S and ^{134}Cs impurities by cation exchange separation, were used to determine the volume partition coefficient (D_v), using standard tracer technique. The best D_v values were obtained using a washing solution of 70% methanol and 30% 4.78 M nitric acid. While the experimental results indicated that anion exchange separation has theoretical interest, it has little practical value because: the partition coefficient is smaller than methods using cation exchange resins; D_v is small which leads to incomplete separation; and pressurization cannot be conveniently used. (CFSTI)

22909 ION EXCHANGE SEPARATION OF RUBIDIUM AND CESIUM. II. CATION EXCHANGE SEPARATION USING NITRIC ACID OR NITRIC ACID–BUTYL ALCOHOL AS ELUANTS. Ho, Shou-ch'un; T'ang, Jen-huan; Sun, I-liang (Peking Univ.). Hua Hsueh Hsueh Pao, 30: 120-4 (1964).

Strong acidic cation exchange resin-42 (phenyl phenol sulfonic acid type changed from sodium form resin to hydrogen form) was used for the separation of Cs and Rb in nitric acid or nitric acid-alcohol mixture. The partition coefficients of Cs and Rb in various HNO_3 and HNO_3-alcohol mixtures were determined using radioisotopes ^{137}Cs and ^{86}Rb as traces in a balance method. The advantages and disadvantages of HNO_3 and HNO_3-alcohol mixture as eluants were compared and it was found that 0.47 M HNO_3 was better than the mixture. (CFSTI)

22910 SELECTION AND DETERMINATION OF PAPER CHROMATOGRAPHIC SEPARATION OF SCANDIUM. P'ang, Shu-wei; Lei, Chien-ch'uan; Liang, Shu-ch'uan. Hua Hsueh Hsueh Pao, 30: 160-5(1964).

Paper chromatography was carried out in an acetone-ethyl ether, ammonium thiocyanate, and HCl mixture to determine the ratios traveled by the solutes and by the solvents (R_f values) for Sc, Th, U and La. The R_f values for Sc and its related elements were also determined using ammonium thiocyanate-HCl mixture with paper impregnated with alkyl amines (tributyl amine, triamylamine, etc.). Using the first mixture and with paper moistened with an alcoholic solution of alizarin the weight ratio of Sc and La that can be separated is 1:10000. When the ratio is lowered to 1:6000 two clear zones can be obtained in the chromatogram. Fourteen reagents that become colored in contact with the solutes were tested for their color sensitivities. It was found that xylenol orange, alizarin, and quinalizarin are the best reagents, and can detect 0.001 μg of solutes. The element in the zone in the chromatogram was determined by cutting the zone out and treating with a mixture of concentrated nitric, hydrochloric, and perchloric acids to dissolve the paper. Subsequent to acid treatment the evaporated residue was dissolved in 5 ml of 2 chloroacetic acid (pH2.9) and 1 drop of 0.1% xylenol orange as indicator and titrated with 1×10^{-4} M di Na-EDTA. 1 μg of Sc can be determined by this method with an accuracy of about ±3%. (CFSTI)

22911 SEPARATION AND DETECTION OF THORIUM AND ZIRCONIUM BY THE RING FURNACE TECHNIQUE. Shen, Shih-nien; Keng, Hsin-tu; K'ang, Ting-hsueh. Hua Hsueh Tung Pao, No. 3, 59-60(1965).

By means of the ring furnace technique, with m-nitrobenzoic acid as the precipitating agent, divalent and trivalent metal ions can be washed up to the loop with a 0.02N HNO_3 solution and thus separated from tetravalent ions. Then, by utilizing an auxiliary ring with a hole diameter of 16 mm, and flushing with 0.2N HNO_3 solution, the thorium is concentrated at the loop of the auxiliary ring while the zirconium is left at the original spot. Finally, the thorium and zirconium can be detected and separated by the usual agents. It was found that 0.2–5 μg of thorium can be separated from mixtures with 0.1–500 μg of zirconium, and that thorium can still be detected and separated in the presence of 700 μg of zirconium. The smallest amount of zirconium that can be detected is 0.1 μg, and the smallest amount of thorium 0.05 μg. The procedure requires only 10–15 minutes, and the common ions (Sn^{4+}, Ce^{4+}, Hg^{2+}) do not interfere. (CFSTI)

22912 RAPID PREPARATION OF WATER SAMPLES FOR MEASURING THE TOTAL BETA-RAY ACTIVITY. Pazdernik, J. (Wasserwirtschaftliches Forschungsinstitut, Prague). Isotopenpraxis, 1: 85-7(Nov. 1965). (In German).

A method for the evaporation and processing of flowing and drinking water samples for measurement of the total β activity was tested. By use of a device made of ordinary laboratory materials, one liter of water can be evaporated within 35 to 40 min. The β activity of a series of drinking and flowing water samples was determined with the proposed method. (tr-auth)

22913 CATHODE-RAY POLAROGRAPHIC STUDY OF YTTERBIUM AND EUROPIUM AND THEIR DETERMINATION IN MONAZITE. Athavale, V. T.; Dhaneshwar, R. G.; Padmanabha Iyer, C. S. (Atomic Energy Establishment, Trombay, India). J. Electroanal. Chem., 11: 291-5(Apr. 1966).

Acetate buffer was found to be a suitable supporting electrolyte for the simultaneous determination of ytterbium and europium. The addition of hydrazine to the

acetate buffer gave an irregular hydrazine reduction wave at −0.90 v and the determination of europium in the mixed supporting electrolyte medium was not feasible. The ytterbium wave was found to increase as a result of the addition of hydrazine to the acetate buffer. The effect of variation in concentration of hydrazine, pH, etc., was studied for ytterbium. None of the other rare earths interfered. Ytterbium and europium were determined in monazite sand. (auth)

22914 RADIOISOTOPIC METHOD OF EVALUATING DISPERSED SYSTEMS. II, SUSPENSIONS. Benedict, L. Kirk; Banker, Gilbert S.; Kessler, Wayne V. (Purdue Univ., Lafayette, Ind.). J. Pharm. Sci., 54: 1659-62(Nov. 1965).

A method for determining the settling rates of suspensions was developed using a specially constructed absorptiometer and a sealed source of β-excited characteristic x radiation. The x-radiation source was immersed in the suspension, and the attenuation of the radiation beam, which passed vertically through a portion of the suspension column, was used to measure the suspensoid concentration in that portion of the column between the source and the bottom of the suspension-containing cell. The method described is proposed as a nondestructive means of determining the sedimentation rates of pharmaceutical suspensions, which contain elements with a high atomic number. Preliminary experiments with several common pharmaceutical suspensions demonstrated the ability of the apparatus to detect the settling of some suspensions long before the appearance of a suspension-supernatant interface. Experience with the absorptiometer revealed inadequacies of the counting system, which could be corrected in subsequent models of the prototype apparatus. An automatic means of recording data, such as a count rate meter used in conjunction with a chart paper recorder, is suggested. To optimize the detection of small changes in suspensoid concentration, the absorption of x radiation might be made selective for some element in the suspensoid by constructing a characteristic radiation source (through choice of a target material of the proper atomic number), which has an energy that just exceeds the critical absorption edge of the element in question. An alternative might be to use a β-emitting isotope as a source of radiation, and to determine the concentration of suspensoid by measuring the characteristic radiation emitted by one of its elemental constituents. (BBB)

22915 NUCLEAR IN VITRO METHOD OF CONTINUOUSLY MEASURING DISSOLUTION RATES. McClintock, William J.; Swarbrick, James; Christian, John E.; Banker, Gilbert S. (Purdue Univ., Lafayette, Ind.). J. Pharm. Sci., 54: 1782-6(Dec. 1965).

A new radioisotope in vitro dissolution-rate measuring apparatus was developed and evaluated for use in measuring the dissolution release of labeled materials from solid dosage forms as a precise means of studying the effects of modifying the different variables of dosage form on the in vitro dissolution of model systems. The new apparatus employed Geiger-Müller detection of a γ emitter and continuous recording of the events. The tracer (^{59}Fe) was incorporated in a standard tablet formulation containing ferric chloride, calcium sulfate, and magnesium stearate. The dissolution-rate constant measured in the apparatus described was compared with the dissolution-rate constants measured in the U.S.P. disintegration apparatus and the rotating bottle. The tablets did not disintegrate, but released the ferric chloride solute by a leaching mechanism according to the model, $Q = k't^{1/2}$. It is suggested that this method of dissolution-rate measurement is the most convenient of the three methods because the presence of an operator was not required after the tablet was introduced; a permanent record of the dissolution of the ^{59}Fe, representative of the ferric chloride dissolution, was made; a chemical analysis with its inherent difficulties in sampling, measuring, etc., was not needed. The radioisotope method is more precise; thus, the variation-rate constants of the U.S.P. and the rotating-bottle methods were 2.7 and 4.1 times greater than the variation-rate constant of the nuclear method. Of the three in vitro methods studied, the U.S.P. method was the most conservative in dissolution-rate measurement (rate constant = 0.856). The isotope method was less conservative (rate constant = 1.56), and the rotating bottle was the least conservative (rate constant = 2.17). This is related to the degree of agitation and solvent exposure of the tablet in the apparatus. (BBB)

22916 RECENT DEVELOPMENTS IN THE SPECTROSCOPY OF URANYL SALTS. Narasimham, K. V. (Defence Science Lab., Delhi). J. Sci. Ind. Res. (India), 24: 618-22(Dec. 1965).

Advances in the spectroscopy of uranyl salts are reviewed. It was established by both experiment and theory that the fluorescence spectrum of these salts is due to a single electronic transition from the lowest excited state to the ground state. There was some evidence for an excited triplet state. It was established that the ligands in the uranyl salts affect the uranyl frequencies to some extent. (auth)

22917 NEUTRON ABSORPTION ANALYSIS. Toelgyessy, Juraj (Slovak Polytechnic Univ., Bratislava). Jad. Energ., 12: 81-8(1966). (In Czech).

Analytical methods using neutron absorption are reported. The principles and methods, apparatus, and techniques of neutron absorption analysis are discussed. Its practical utilization is considered with a discussion of the advantages and disadvantages of the method. (tr-auth)

22918 GAS CHROMATOGRAPHY IN NUCLEAR RESEARCH. Lukac, Sava (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Jad. Energ., 12: 130-9(1966). (In Czech).

Gas chromatography applications in nuclear research are reviewed. The inactive gas chromatography, and namely gas chromatography of radioactive substances are used in this field. In both cases, the weight of the problem lies more in methodic differences of dosing and detection system than in the column separation. Gas chromatography may be applied in reactor material research and production for the investigation of their changes during reactor operation, and in the production and utilization of radioisotopes. (P.C.H.)

22919 VOLUMETRIC METHOD FOR DETERMINING URANIUM IN URANIUM ORE USING ALUMINUM FOIL AS THE OXIDIZING AGENT. Li, Kuan-hua; Ting, Fu-chang. K'o Hsueh T'ung Pao, No. 6, 533-4(1964).

An improvement on the original phosphate method for the determination of uranium in uranium ores developed by P. N. Paley (proceedings of the International Conference on the Peaceful Uses of Atomic Energy, Geneva (1955), P/629, vol. 8, p. 225, United Nations, N. Y. (1956)), is described. The new method, which substitutes aluminum foils for $Na_2S_2O_4$ as oxidizing agent, is more convenient, economical, and safe, and eliminates the interference of copper ions and the dissociation products of $Na_2S_2O_4$. The method consists of diluting 2.36 ml of 0.005114 N uranium phosphate standard solution to 100 ml, adding concentrated hydrochloric acid to make a 6% acid solution, adding 0.5 g aluminum foils and 15 ml 10% Na_2HPO_4. The solution is heated to boiling. After the solution is cooled 5 ml of 0.5% $ThCl_4$ is added and allowed to coprecipitate. A small amount of benzene is added and the mixture and precipitates are allowed to stand overnight. Sulfuric acid is used to dissolve the quadrivalent uranium phosphate and the resultant acidic solution is titrated with ammonium vanadate. The effects of settling period after coprecipitation, variation of uranium concentration, the acidity of HCl in solution, and the interference of molybdenum and copper ions are tabulated. The accuracy of this method was verified by comparing with other methods and the original phosphate method. (TCO)

22920 QUANTITATIVE DETERMINATION OF TWO γ-RADIATING ISOTOPES IN THE PRESENCE OF EACH OTHER WITH THE AID OF A SINGLE-CHANNEL AMPLITUDE ANALYZER. PART I. Csanyi, Piroska; Gallyas, Miklos; Levay, Bela (Eotvos Lorand Scientific Univ., Budapest). Magyar Kem. Foly., 71: 127-32(Mar. 1965).

The quantitative determination of ^{22}Na and ^{137}Cs was made in the presence of ^{131}I using a single-channel amplitude analyzer and the spectra were evaluated by three different methods. The method described by Covell, D. F., (Analytical Chemistry, Vol 31, 1959, p 1785) gave the most accurate interpretation; however, this technique was more time-consuming than the other two investigated. (CFSTI)

22921 USE OF THE IRON RHODANIDE METHOD FOR QUANTITATIVE DETERMINATION OF PEROXIDE CONTENT IN RADIATION-OXIDIZED POLYVINYLCHLORIDE. Zeppenfeld, G. (Institut fuer Angewandte Physik der Reinststoffe, Dresden). Makromol. Chem., 90: 169-76 (1966). (In German).

The amount of peroxides in ^{60}Co γ-irradiated polyvinylchloride (PVC) was investigated in attempts to elucidate the processes involved in the degradation of polymers irradiated in the presence of oxygen. A modified method for determining the peroxide oxygen in PVC, based on the ferrous thiocyanate method is described. The principle of this method is based on the reduction of peroxide by iron(II) ion in the presence of sulfuric acid as well as on the colorimetric measurement of the resulting iron(III) as a thiocyanate complex. This method allows the quantitative determination of the peroxides in the presence of unsaturated compounds, and at a low limit of the sensitivity (1×10^{-6} mole/l) it is just as dependable as the well-known methylene-blue method. It is shown from a comparison of these two methods that the described one is more advantageous, particularly in the use of stable, commercial reagents. To determine the peroxide oxygen in PVC a mixture of benzene and inorganic salts dissolved in methanol is added to a 1% solution of this material in tetrahydrofurane. By aid of this method the presence of hydroperoxides in γ-radio-oxidized PVC was confirmed. (BBB)

22922 INVESTIGATIONS IN CONNECTION WITH THE SPECTROPHOTOMETRIC DETERMINATION OF PRASEODYMIUM IN THE PRESENCE OF NEODYMIUM. Auer-Welsbzch, Helga (Univ., Vienna). Monatsh. Chem., 96: 1611-16(1965). (In German).

Interference by the background in the photometric determination of Pr in $NdCl_3$ solutions may be overcome by the correction $E_{obs} - E_0 = k \cdot C_{Nd}$, using water as reference. Only the absorption band at 444 nm may be used; the absorption bands at 468 nm and 482 nm are too strongly influenced by the Nd absorption bands at 469 nm and 476 nm. Experiments were performed in which constant Pr concentration and varying Nd concentrations were examined at 444 nm. Tabular results are presented. The correction factors derived from the table are valid for the concentration range 0.05 g Pr/100 ml to 0.4 g Pr/100 ml. For the following concentration units of Nd, the k factors are: g Nd/100 ml, 0.0020; g $NdO_{1.50}$/100 ml, 0.0017; and mol/1, 0.0289. At higher Pr concentrations (>8 atom % Pr in Nd) no correction is necessary. Other studies using Nd solutions of proper concentration as reference were carried out; the Beer-Lambert law was obeyed at 444 nm up to E = 0.5 for the solutions tested. (BBB)

22923 CONCENTRATION OF RADIONUCLIDES IN SEA WATER BY FERRIC HYDROXIDE CATION EXCHANGE RESIN. Watari, Kazuo (National Inst. Radiological Science, Japan); Tsubota, Hiroyuki; Koyanagi, Taku; Izawa, Masami. Nippon Genshiryoku Gakkaishi, 8: 130-3(1966). (In Japanese).

It is generally difficult to concentrate trace amounts of metals present in sea water because of the high salt concentration. The method reported is based on the fact that radionuclides in a solution can be adsorbed on a ferric hydroxide cation exchange resin. The resin was prepared by converting a hydrogen form of Dowex 50 W, X 8, to ferric form, and then transforming it to ferric hydroxide in the resin by adding ammonium hydroxide. Experiments were carried out by the batch method: 50 ml of sea water containing radionuclides were shaken with 0.5 g of air-dried resin. ^{144}Ce, ^{95}Zr, and ^{106}Ru were quantitatively adsorbed on the resin, while ^{85}Sr and ^{137}Cs were adsorbed by about 35 and 15%, respectively. The resin could also be applied to the concentration of radionuclides in natural waters. (auth)

22924 NATURAL INORGANIC DECONTAMINATING AGENTS FOR ^{134}Cs AND A MIXTURE OF ^{90}Sr AND ^{134}Cs IN WATER. Galea, V.; Birsan, E. T.; Uray, Ildiko (Medical-Pharmaceutical Inst., Cluj. Inst. of Hygiene and Labor Safety, Cluj). Rev. Chim. (Bucharest), 16: 456-8 (Sept. 1965).

The decontaminating effectiveness of crude gypsum, commercial superphosphate, and 4 varieties of bentonite for solutions of ^{134}Cs alone or mixed with ^{90}Sr and ^{90}Y was studied. The effects of varying the proportions of decontaminating agents and of varying the pH of the solution was also studied. (CFSTI)

22925 STUDY OF CHELATE COMPLEXES OF MANY AZO DYES WITH INORGANIC CATIONS. Navratil, O. (Univ., Brno). pp 112-18 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.1]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965]. (In Czech).

The use of 1-(thiazolylazo)-2-naphthol and 1-(pyridylazo)-2-naphthol for extraction of complexes with inorganic cation in benzene was investigated. The azido basic equilibrium and the distribution equilibrium of the dyes were measured spectrophotometrically and potentiometrically. Complexes of the dyes with Zn, Cu, Ag, Co, and Eu were investigated spectrophotometrically and radiometrically. (tr-auth)

22926 INVESTIGATION OF THE BACKSCATTERING OF β RADIATION AND ITS USE IN ANALYTICAL CHEMISTRY. Jirkovsky, Rudolf; Struminsky, Karel (Katedra Analyticke Chemie a Radiochemie VSB, Ostrava, Czechoslovakia). pp 234-50 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.2]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1955]. (In Czech).

Some physical properties of radiation scattering and the mechanisms connected with its use in analytical chemistry are reported. The dependence of β backscattering on atomic number was investigated experimentally. The dependence of β backscattering on the position of the irradiated sample and the shape of the ionization chamber was also investigated. The effects of ash content and humidity of the samples were determined. These studies served as a theoretical basis for investigation of the possibility of using β backscattering in the rapid analysis of metallurgical samples. (tr-auth)

22927 β BACKSCATTERING AND ITS ANALYTICAL APPLICATIONS. Krivan, Viliam; Varga, Stefan (SVST, Bratislava). pp 257-73 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.2]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965]. (In Czech).

The phenomenon of β backscattering and the conditions of its applications in analytical chemistry are considered. Factors that affect the backscattering coefficient are evaluated and discussed. These are the geometry of the radiator and detector, atomic number and layer density of the sample, and energy of the original radiation. The selection of the radioisotope and the detection methods and the possibilities for increasing measurement sensitivity are described. The advantages of this analytical technique are considered. (tr-auth)

22928 THE NONDESTRUCTIVE NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL MATERIALS WITHOUT THE USE OF γ SPECTROMETER. Rakovic, Miloslav (Charles Univ., Prague). pp 299-311 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.2]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965]. (In Czech).

A nondestructive method for the determination of sodium in biological materials, based on detection of γ rays in the activated sample by means of a scintillation counter, was developed. Beta radiation was eliminated by a filter. Phosphorus could be determined by the elimination of the ^{24}Na and ^{42}K effect by a decay period. A method for determina-

tion of potassium based on measurement of the β activity using a single or differential filtration did not give satisfactory results. (tr-auth)

22929 STUDIES ON SOME FACTORS WHICH ARE VALID IN THE DETERMINATION OF COAL ASH BY β BACKSCATTERING. Schiller, P.; Dolan, P.; Hudec, P. (Komensky Univ., Bratislava). pp 312-22 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.2]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965]. (In Czech).

In construction of a device for determination of the ash in coal, based on intensity measurements of backscattered β radiation, some factors were studied that can modify the accuracy of the determination. The effects of the ratios of the ashing units, especially iron, calcium, and silicon, were studied. The effects of moisture, granularity, and homogeneity of the coal and the volume weight of the sample on the determination accuracy were investigated. The experimental results are reported. (tr-auth)

22930 NEW METHODS OF RADIOMETRIC MASS ANALYSIS. Toelgyesy, Juraj; Braun, Tibor (Slowakische Chemische Hochschule, Bratislava. L. Eoetvos Univ., Budapest). pp 330-52 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.2]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965]. (In Czech).

Methods for radiometric mass analysis that were developed at the L. Eötvös University in Budapest and the Technische Hochschule in Bratislava are reported. Complexometric, redox, β backscattering, β absorption, and radiocoulometric titration methods were studied. These methods expand significantly the range of radiometric titrations. (tr-auth)

22931 COMBINATION NEUTRON EXPERIMENT FOR REMOTE ANALYSIS. Caldwell, R. L. (Socony Mobil Oil Co., Inc., Dallas); Mills, W. R.; Jr.; Allen, L. S.; Bell, P. R.; Heath, R. L. Science, 152: 457-65(Apr. 22, 1966).

Neutron techniques for chemical analysis of lunar and planetary surfaces are described. Four measurements (prompt, capture, die-away, and activation) constitute an improved combination method of neutron analysis that can be performed with a single instrument. The basic requirements for the instrument are a scintillation crystal detector, a miniature accelerator neutron source that can be pulsed, a multichannel analyzer with pulse-height and time-analysis modes, and a programmer to control the overall experiment. The source, attenuator, and detector are arranged in a straight line, which may be either parallel or perpendicular to the surface to be analyzed. No preparation of samples is required. Results of preliminary experiments are presented. (M.C.G.)

22932 STEROID GAS-LIQUID RADIOCHROMATOGRAPHY: CONTINUOUS MONITORING OF THE EFFLUENT FOR ^{14}C AND TRITIUM. Sommerville, Ian F.; Collins, William P. (Chelsea Hospital for Women, London). Steroids, Suppl. 2, 223-34(1965).

A radioisotope method was developed for quantitative determination of steroids of predominantly ovarian origin in body fluids and tissues using techniques that would be sensitive and specific and yet not so laborious as to complicate serial analyses in human subjects. Use of gas-liquid chromatography for steroid analysis has definite advantages over previous methods for determination of sub-microgram amounts of steroids in extracts of biological material, and it is especially advantageous to monitor the effluent gas for radioactivity derived from tritiated and ^{14}C-labeled steroids. Since the sensitivity of most detectors used for gas chromatography is lower than that of techniques for the measurement of radioactivity, and for other reasons, the use of proportional counting for the continuous recording of radioactivity was investigated. The system devised is illustrated. The total effluent is led through an argon detector into the combustion tube; the tube contains cupric oxide, which oxidizes organic material to carbon dioxide and water, and iron filings, which reduce the water vapor. The carrier gas (argon) is then diluted by appropriate concentrations of carbon dioxide (5% of the total flow) and hydrogen. The current pulses from a proportional counter are amplified and fed to a ratemeter and thence to a recorder, which shows either the rate at which pulses arrive, a differential trace consisting of a series of peaks, or the integral number of pulses. In general, a differential radiochromatogram was used for identification of radiometabolites when gonadal tissue was incubated with isotopically labeled steroid substrates. This proved to be a useful technique and complements a procedure developed for investigation of ovarian function. The use of gas-liquid radiochromatography for the identification of unknown radiometabolites is illustrated by several examples, and application of this technique to the quantitative determination of steroid concentrations in body fluids and tissues is described. (BBB)

22933 OPTIMIZATION OF GAMMA-RAY COUNTING AND SPECTROMETRY IN BIOMEDICAL TRACER STUDIES. Guinn, V. P. (General Dynamics Corp., San Diego, Calif.). pp 17-31 of STI-PUB-106.

In biomedical tracer studies, especially in man and even more so in children and pregnant women, it is important to operate at the lowest possible level of administered radioisotope that is commensurate with the required precision and accuracy of the subsequent radioassay measurements. Similarly, with administered stable elements (as specified) or enriched stable isotopes (again, in compound form), followed by radioactivation analysis of resulting samples, it is important from the toxicological standpoint to minimize the amounts of administered element. The problem of optimization of counting of one, two, and three gamma-emitting radioisotopes, by NaI(Tl) scintillation counting, single-channel spectrometry and multichannel spectrometry is discussed with particular attention to single-, double-, or triple-tagging tracer studies with radioisotopes frequently used in biomedical studies: ^{51}Cr, ^{198}Au, ^{75}Se, ^{197}Hg, ^{64}Cu, ^{76}As, ^{82}Br, ^{59}Fe, ^{60}Co, ^{42}K, and ^{24}Na. The same considerations apply to the widely-used thermal-neutron activation analysis determinations of the corresponding elements or enriched stable isotopes, so the results of these counting optimization calculations have a double usefulness. The calculations are based on a few reasonable assumptions made on practical biomedical considerations, namely: (1) small samples ($\leq$10 ml), (2) moderate counting periods ($\leq$20 minutes), (3) modest allowable decay periods ($\leq$3 days) and (4) use of commercially available counting equipment and shielding. On this basis, the most sensitive methods of counting each of the aforementioned radioisotopes, and a number of pairs and trios of them, were ascertained. The counting variables included in the considerations are: (1) type of NaI(Tl) crystal, i.e., solid or well-type, (2) size of NaI(Tl) crystal, up to a 5 in. $\times$ 5 in. size, (3) type of measuring equipment: simple scalar, single-channel pulse-height analyzer, or multichannel pulse-height analyzer. The minimum detectable sample specific activity was computed for each optimum counting situation, as well as the levels needed for statistical accuracies (expressed as standard deviations) of $\pm$20%, $\pm$10%, $\pm$5%, and $\pm$2%. In a number of illustrative cases, the calculated limits were compared with experimentally determined values. Special attention was devoted to the best conditions for minimization of contributions from lead x rays, backscattered gamma-rays, escape peaks, sample beta particles, and bremsstrahlung. (auth)

22934 UNSCRAMBLING OF GAMMA-RAY SPECTRA IN THE STUDY OF THORIUM METABOLISM. Parr, R. M. (Argonne National Lab., Ill.). pp 79-92 of STI-PUB-106.

The metabolism of natural thorium and its radioactive daughters has been a subject for intensive research since the observation of pathological changes following injections of the radiographic contrast medium, Thorotrast. The estimation of internal radiation dosage in tissues containing this material is complicated by the fact that several of the radioactive daughters are sufficiently long-lived that, during life, they can migrate readily from one organ to another. As a means for investigating the magnitude of the radiation dosage a procedure was developed for estimating

the activities of up to six of the daughter isotopes in small samples of tissue collected and prepared for analysis within one hour of death. The samples were assayed without prior chemical processing by gamma-ray spectrometry, and the growth and decay of their various radioactive components were followed for a period of up to one month. A minimum of three measurements were required in order to establish the necessary parameters of the growth and decay curves. They were made at the following approximate times after death: (i) less than one hour, (ii) two days, (iii) two or more weeks. The processing of the spectrometer data was accomplished in two steps. The first was an unscrambling procedure for resolving each gamma-ray spectrum into its three major components, ^{228}Ac, ^{212}Pb, and ^{212}Bi, and computer programs were written for unscrambling by two different methods, namely: the matrix method and the method of least-squares. The second step in the computation was the solution of the Bateman equations, which describe the growth and decay of ^{228}Ac, ^{212}Pb, and ^{212}Bi as functions of time, and of the initial activities of each daughter isotope in the decay series. An iterative procedure was used which yielded estimates of the activities of each of the following six isotopes at the time of death: ^{228}Ra, ^{228}Ac, ^{228}Th, ^{224}Ra, ^{212}Pb, and ^{212}Bi. The minimum levels of detection were generally less than 2 pC/g of sample. Analyses of various human and animal tissues showed that very significant degrees of radioactive disequilibrium occur in the tissues of animals injected with Thorotrast, particularly when the short-lived isotopes ^{212}Pb and ^{212}Bi are used. (auth)

22935 TECHNIQUE FOR THE MEASUREMENT OF LOW-LEVEL RADIOACTIVITY OF ORGANIC IODINE IN LARGE-VOLUME URINE SAMPLES. Nicolesco-Zinca, D.; Matei, I. (Inst. of Endocrinology, Bucharest). pp 119-26 of STI-PUB-106. (In French).

In radioisotope tracer studies of endocrinology there are two major problems connected with the determination of renal excretion of iodine in the form of organic compounds labeled in vitro with ^{131}I, namely: (a) their quantitative separation from the iodide also present in urine, even if the concentration of the iodide is twenty times greater; and (b) the determination of their low-level radioactivity in large-volume urine samples, their concentration per millilitre of urine being approximately 10^{-5} of the dose administered which, in turn, must be as low as possible. Classically, separation is carried out by paper chromatography, for which only small samples of urine are used. This technique requires time and equipment for chromatography. Determination of radioactivity on paper involves contamination of the entire band. In spite of correction, only 89.9% of the radioactivity is recovered, and even less when an extract of butanol is used. A technique is described in which a large volume of urine sample is passed through a microcolumn of H^+ cation-exchange resin. The organic compounds of the radioiodine remain fixed on the cation-exchange resin and their radioactivity is measured by means of a NaI(Tl) crystal well-type scintillator. On verification for the given conditions, the recovery of the urine diiodotyrosine was complete, with a standard error averaging 0.42% for 10 experiments. This method was used for determining the deiodation of diiodotyrosine in 11 patients with normal deiodation and in 10 cretins with goiter, of whom five showed a deficiency of deiodation. The dose administered was 1 μC of diiodotyrosine-^{131}I. The method allows for the administration of a radioactive dose at least 50 times lower than in classical methods, and makes possible the separation of diiodotyrosine and its recovery from a sample of 40 to 50 ml of urine (with a standard error of 0.42% in a period of a few hours) using NaI(Tl) well-type crystal scintillation equipment, which is currently available in nuclear medical laboratories. (auth)

22936 DETERMINATION OF URANIUM IN URINE BY DELAYED NEUTRON COUNTING. Brookes, I. R. (Atomic Weapons Research Establishment, Aldermaston, Eng.). pp 265-81 of STI-PUB-106.

A method is described for ^{235}U assay in urine by counting delayed neutrons emitted following the fission of ^{235}U in the sample with thermal neutrons. The three groups of neutrons of interest have half-lives of 55.72, 22.72, and 6.22 sec. A 100-ml sample of urine is evaporated to dryness on a water bath. The residue is transferred with about 4 to 5 ml of water to a 1-oz polythene bottle which is then heat sealed. The sample bottle is put into a rabbit and sent through a pneumatic tube system to the HERALD reactor core where it is irradiated in a thermal flux of 3.94×10^{12} n cm^2/sec. The sample automatically returns to the laboratory after 60 sec irradiation where the sample bottle is transferred to the counter. This counter is switched on 25 sec after the sample has left the reactor and counts the sample for 1 min. Blank samples consist of urine from persons occupationally unexposed to uranium and the calibration standard is a known amount of ^{235}U (as natural uranium). The limit of detection is 0.020 pC of 93% enriched (0.007 of the maximum permissible body-burden) and 0.036 μg of natural uranium per 100 ml of urine. The limit of detection is governed by the magnitude of the blank count. The main component of the blank is the response of the counter to γ radiation from activation products in irradiated urine. The counting and irradiation cycle takes about 3.5 min and 50 samples at one time may be evaporated and bottled in the working day. Interference from ^{239}Pu is likely to be negligible for the purposes of urine analysis. (auth)

22937 SAMPLE PREPARATIONS USED IN BIOMEDICAL RESEARCH AND TRAINING AT THE SPECIAL TRAINING DIVISION OF THE OAK RIDGE INSTITUTE OF NUCLEAR STUDIES. Akers, L. K. (Oak Ridge Inst. of Nuclear Studies, Tenn.). pp 283-94 of STI-PUB-106.

A wide variety of sample preparations for medical tracer studies is described. These range from simple source holders such as metal, cardboard, and plastic source mounts, to precipitation devices using stainless steel and fiberglass mounts, and special source holders for liquid counting of samples. In addition to these techniques, a number of procedures of special interest in biomedical problems have been developed. One of the most important of these is the use of a catalytic synthesis of benzene which has been developed to the point to which an over-all yield of better than 90% is obtained. This synthesis can be used for carbon-containing compounds of interest in low-level tracing experiments and age dating problems. Since the synthesis involves the production of carbon dioxide at one step and the hydration of metallic carbide in another, it can be used either for the measurement of ^{14}C or ^{3}H or both in double labeling experiments. Special techniques for the preparation of biological materials for activation analysis and other radiochemical procedures are described. Since the problem of resolution in alpha-ray spectroscopy remains a very difficult one, considerable work carried out by the oceanography and environmental studies group in the development of very thin samples which are capable of permitting higher resolution of alpha-ray spectra is described. These employ electrodeposition procedures from mixed solvents. Measurements are made with a special bank of Fairstein-Frisch grid counters associated with a 512-channel analyzer for simultaneous recording of more than one spectrum. Solid-state detectors are also used and comparative results of gridded and solid-state detectors are discussed. (auth)

22938 BIOLOGICAL MONITORING FOR ^{241}Pu. Dalton, J. C.; McDonald, B. J.; Barnes, V. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). pp 347-61 of STI-PUB-106.

The origin and characteristics of ^{241}Pu are described, with special emphasis to its consideration as a health hazard, and to the problem of its determination. A counting system is described for the low-level quantitative assay of ^{241}Pu in samples from a biological monitoring program. The technique at its present stage of development is at least as sensitive as procedures previously reported, and represents an improvement in terms of simplicity, rapidity, and economy. The procedure is intended primarily for use in urine analysis to supplement information already obtained from autoradiographic analysis of α-active plutonium

isotopes. The same source disc is used for ^{241}Pu assay thereby economizing in preparative effort. The isotopes of plutonium are first separated from the sample of urine, or other biological material, in a state of high radiochemical purity using an anion exchange procedure. They are then electrodeposited onto a stainless steel disc. A direct count of the ^{241}Pu soft beta-ray spectrum (maximum energy 20 kev, half-life 13.3 years) is obtained in an anti-coincidence system consisting of a small-volume gas-flow proportional counter with a plastic phosphor scintillation anti-coincidence guard. The dimensions are such that all the plutonium β-particles are absorbed within the proportional counter while the α-particles dissipate about half their energy within the plastic phosphor. The geometry for both radiations is almost 2π. At its present stage of development the equipment will detect 3 pC of ^{241}Pu in a counting time of one hour. This represents the 24 hr urinary excretion rate 3 months after the intake of about 5% of a maximum permissible body-burden (0.9 μC). The discs are subsequently assayed for α-active plutonium isotopes by exposure for one week to a nuclear track plate which is then examined visually using a microscope. (auth)

22939 EFFICIENCY OF MEASUREMENTS OF RADIOACTIVITY IN RELATION TO SAMPLE PREPARATION AND MEASURING ARRANGEMENT. Meissner, J. (Borstel Research Inst., Ger.). pp 563-72 of STI-PUB-106.

Different methods for measuring radioactivity routinely in biological tracer studies are compared in terms of their absolute sensitivities. The data were obtained by measurement of samples prepared from standard solutions of various radioactive nuclides (^{3}T, ^{35}S, ^{131}I, ^{204}Tl, ^{147}Pm, ^{32}P). The nature and method of preparation of the sample depend on chemical and physical properties of the elements in question and on the β-energy of their radioactive isotopes as well as on the type of measuring apparatus to be used. The following devices used in routine work are compared in this paper: Geiger-Müller counter tubes with end windows of different thickness (mass per unit area), liquid sampling jacketed G-M tubes, gas flow counters, low background counters (Omniguard, Tracerlab), liquid scintillation spectrometers (Tricarb, Packard), gas analysis counters (Frieseke and Hoepfner), large window G-M counters (Kiefer-Maushart) and scanners for paper chromatograms (Packard). Lower limits of detection for the various radioactive nuclides are estimated from data on background and sensitivity of the various devices. In deriving these limits the time for measuring the samples is considered not to exceed 20 min. Furthermore, both sample and background counting rates are considered to be measured for identical times and are therefore subject to similar statistical errors. The detection limits then represent amounts of radioactivity which can be detected to a stated degree of statistical significance as compared with random variations in background. From the results thus achieved it is obvious that the total yield of sample measurements, i.e., the ratio of impulse rate detected by the tube to the rate of transmutations in this sample, is influenced by very differing components depending on preparation. Self-absorption will affect especially results obtained from solid samples containing emitters with low β-energy. The counting of liquids in jacketed tubes is limited by the thickness of the tube glass wall. For ^{14}C and ^{3}H measurements, optimal efficiency will be obtained with gas analysis counters and liquid scintillation sets, the latter being superior on account of simpler procedures and more reliable results. (auth)

22940 DETERMINATION OF IMPURITIES IN STEEL BY NEUTRON-ACTIVATION ANALYSIS. Babikova, Yu. F.; Minaev, V. M.; Samosadnyi, V. T. (Moscow Inst. of Engineering Physics). Zavodsk. Lab., 32: 47-9(1966). (In Russian).

The possibility of the rapid analysis of steel for O_2, Al, Se, P, and S impurities was investigated. The dependence of the sensitivity of the radioactivation analysis on various factors is reported and the sensitivity of the determination by neutron activation evaluated. The neutrons used were obtained by (T,D) and (d,D) reactions in neutron generators. (tr-auth)

22941 ANALYSIS OF RARE EARTH SALTS IN NONAQUEOUS SOLUTIONS. Kreshkov, A. P.; Yarovenko, A. N.; Milaev, S. M.; Aldarova, N. Sh. (Mendeleev Chemico-Technological Inst., Moscow. East-Siberian Technological Inst., Ulan-Ude, USSR). Zh. Anal. Khim., 21: No. 1, 34-9(1966). (In Russian).

The behavior of rare earth nitrates in nonaqueous solutions was studied. It was found that in a methanol–acetone (1 : 4) medium they behave as acids. On this basis the following methods for determining rare earths were developed: a method for determining rare earth nitrates separately and in their mixtures by their direct potentiometric titration with a standard benzene–methanol solution of tetraethylammonium hydroxide or a methanol solution of tetramethylammonium hydroxide in a methanol–acetone medium; and a method for the analysis of multicomponent mixtures of rare earth nitrates with nitrates of other elements and HNO_3 by the direct potentiometric titration of the components, which behave as acids of different strength in a methanol–acetone medium, with a standard nonaqueous base solution. (auth)

22942 SUCCESSIVE EXTRACTION-PHOTOMETRIC DETERMINATION OF IRON(III), VANADIUM(V) AND URANIUM(VI) AS CINNAMOYLPHENYLHYDROXYLAMINATES. Zharovskii, F. G.; Sukhomlin, R. I. (Kiev State Univ. Kiev Tech. Inst. of the Food Industry). Zh. Anal. Khim., 21: No. 1, 59-64(1966). (In Russian)

A study was made of the extraction of iron(III), vanadium (V), and uranium(VI) as their compounds with N-cinnamoyl-N-phenylhydroxylamine. An extraction-photometric method was developed for determining vanadium, iron, and uranium by successive extraction of their cinnamoylphenylhydroxylaminates. The method was tested on the artificial mixtures. The results were reasonably reliable. (auth)

22943 LUMINESCENT DETERMINATION OF URANIUM IN SOLUTIONS IN THE PRESENCE OF EXTINGUISHING METALS. Osipov, B. S. (Moscow Geological Prospecting Inst.). Zh. Anal. Khim., 21: No. 1, 70-5 (1966). (In Russian).

Iron has an extinction effect on the luminescence intensity of sodium fluoride beads activated with uranium. The degree of extinction depends on the concentration of iron and uranium in the melt. Up to 0.001 g/l of iron at any initial uranium concentrations and up to 0.01 g/l of iron in samples with more than 0.001 g/l of uranium has no effect on the luminescence of beads. The method of additions can be successfully used within 0.01 to 1.0 g/l of iron. The ratio of uranium concentrations in the analyzed and added solutions should be from 1 : 1 to 1 : 3 at small concentrations of uranium and iron and not more than 1 : 5 at large concentrations. (auth)

22944 MICROVOLUMETRIC COMPLEXONOMETRIC DETERMINATION OF NEPTUNIUM. Smirnov-Averin, A. P.; Kovalenko, G. S.; Ermolaev, N. P.; Krot, N. N. Zh. Anal. Khim., 21: No. 1, 76-8(1966). (In Russian).

Complexonometric titration of neptunium(IV) is possible in the presence of Xylenol Orange. One determination takes 2 hr; the experimental error is ±0.03 mg. Neptunium can be determined in pure solutions and in solutions containing a number of impurity elements. (auth)

22945 CHEMICO-SPECTROGRAPHIC DETERMINATION OF MICROAMOUNTS OF Mn, Ni, Co AND Cu IN LANTHANUM OXIDE. Kharkover, M. Z.; Desyatkova, M. A.; Barkovskii, V. F.; Mitropol'skaya, N. A.; Ganopol'skaya, T. A. (Gorkii Ural State Univ., Sverdlovsk, USSR). Zh. Anal. Khim., 21: No. 1, 94-7(1966). (In Russian).

The possibility was studied of using 8-mercaptoquinoline (thiooxine) for concentrating microamounts of Mn, Ni, Co, and Cu from lanthanum oxide. A chemicospectrographic method was developed for determining microamounts of Mn, Ni, Co, and Cu in lanthanum oxide with a sensitivity of 2×10^{-5}%. (auth)

22946 DETERMINATION OF HEXACHLOROCYCLOHEXANE ISOMERS BY THE ISOTOPE-DILUTION METHOD USING ^{36}Cl. Kulikova, M. N.; Strongin, G. M.; Prokhorova, M. I.; Khokhlova, L. F. (Kalinin Chernorechensk Chemical Plant, Dzerzhinsk, USSR). Zh. Anal. Khim., 21: No. 1, 103-9(1966). (In Russian).

A method was developed for the synthesis of hexachlorane labeled with ^{36}Cl by means of sodium chloride. A method was also developed for the determination of α, γ, and δ isomers in any samples containing hexachlorane. The experimental error is 1 to 3%. Methods were suggested for separation and purification in individual hexachlorocyclohexane isomers and for the ^{36}Cl regeneration from the waste of radioactive hexachlorane. (auth)

22947 DETERMINATION OF IONIUM AND TOTAL THORIUM ISOTOPES IN URANIUM MATERIALS. Palei, P. N.; Karalova, Z. K.; Shibaeva, N. P.; Pyzhova, Z. I. Zh. Anal. Khim., 21: No. 1, 126-8(1966). (In Russian).

A method for determining ionium (^{230}Th) (4×10^{-4} to 5×10^{-5}%) and the total of other thorium isotopes (5×10^{-3} to 1×10^{-4}%) in uranium materials is described. Thorium isotopes are isolated on calcium oxalate and impurities are separated on a AB-17 anion exchange resin in 8N HCl. Ionium is determined by means of an alpha scintillation counter; the total thorium isotopes are determined photometrically with arsenazo III. (auth)

22948 DETERMINATION OF EXCHANGEABLE CALCIUM AND STRONTIUM IN SOILS. Pavlotskaya, F. I.; Tyuryukanova, E. B.; Blokhina, M. I. (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim., 21: 157-62(1966). (In Russian).

A method was suggested for extracting exchangeable strontium and calcium from soils by continuous passage of a 1 N solution of ammonium acetate through a layer of soil. This method permits a large number of samples to be analyzed simultaneously. The working time needed for a single determination is short. (auth)

22949 DETERMINATION OF RARE EARTHS WITH XYLENOL ORANGE. Tikhonova, A. A.; Timofeeva, N. I. Zh. Anal. Khim., 21: 289-91(1966). (In Russian).

The possibility of using Xylenol Orange for determination of La, Sm, Eu, Dy, Gd, and Er was studied. Conditions were established for eliminating the effect of Cr, Ni, Ti, and Fe. Photometric (at 0.1% and less of rare earths) and a titrimetric (at 1% and more) methods with Xylenol Orange can be used for determining rare earths in oxides, ceramic material, heat-resistant alloys, and other materials. (auth)

22950 DETERMINATION OF RARE EARTHS IN CERTAIN MINERALS AND ROCKS BY A RADIOACTIVATION METHOD. Lobanov, E. M.; Gureev, E. S.; Dutov, A. G.; Kist, A. A. (Inst. of Nuclear Physics, Tashkent). Zh. Anal. Khim., 21: 292-5(1966). (In Russian).

A rapid method was developed for determination of some rare earths in geological samples by neutron activation. The method includes a rapid radiochemical treatment of the irradiated material followed by γ-spectrometric analysis on a multichannal analyzer. (auth)

22951 INTERACTION OF TETRAVALENT PLUTONIUM WITH XYLENOL ORANGE. Milyukova, M. S.; Nemodruk, A. A. Zh. Anal. Khim., 21: 296-301(1966). (In Russian).

The interaction of tetravalent plutonium with Xylenol Orange in nitric acid solutions was studied by a spectrophotometric method. It was found that 0.1M HNO_3 is the optimum medium for photometric determination of tetravalent plutonium. Under these conditions plutonium and Xylenol Orange interact in the molar ratio of 1:1. The absorption maximum of the complex formed is at 560 mμ; the apparent molar extinction coefficient is 20,000 ± 200. Hexavalent uranium in amounts 5000 to 6000 times as great as plutonium does not interfere with plutonium determination by means of Xylenol Orange. (auth)

22952 RADIOLUMINESCENT ANALYSIS. COMMUNICATION 2. RADIOLUMINESCENT DETERMINATION OF SOME GASES. Kokoulin, V. G. Zh. Anal. Khim., 21: 334-7(1966). (In Russian).

Extinction of radioluminescence with oxygen, carbon monoxide, sulfur dioxide, nitric oxide, chlorine, and hydrogen sulfide was studied for some liquid luminophores. The possibility is shown of the quantitative radioluminescent determination, from 0.05 to 3 vol %, of oxygen, less than 0.01 mg of chlorine, and less than 0.01 μg of nitric oxide in different gases (argon, nitrogen, hydrogen, carbon dioxide, and butane-, propane). (auth)

22953 COMPLEXONOMETRIC DETERMINATION OF THORIUM IN URANIUM IN THE PRESENCE OF TRIBUTYL PHOSPHATE. Ryabinin, A. I.; Afanas'ev, Yu. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Zh. Anal. Khim., 21: 374-6(1966). (In Russian).

A method was suggested for determining not less than 0.1% of thorium in uranium by complexonometric titration using Xylenol Orange as an indicator in nitric acid solutions in the presence of tributyl phosphate and a salting-out agent. Tributyl phosphate is used to remove large amounts of uranium interfering with titration. The experimental error for about 0.1% thorium is not more than 5%. (auth)

22954 SPECTRAL ANALYSIS OF COMPLEX GAS MIXTURES USING ISOTOPIC DILUTION. Nemets, V. M.; Petrov, A. A. Zh. Prikl. Spektrosk., 4: 101-4(Feb. 1966). (In Russian).

A method of spectral analysis of complex-gas mixtures with the use of isotopic dilution is described. The sensitivity of hydrogen determination in complex mixtures makes up 0.1% at a possible error of determination 10% (relative). The sensitivity of nitrogen determination in such cases amounts 0.5% at a possible error of determination 7–8% (relative). A method of combined determination of nitrogen and hydrogen in complex mixtures using the two-slit diffraction monochromator is developed. Optimal working conditions (without electrode-cooled quartz discharge tube with inner diameter 1–2 mm) are found. (auth)

22955 L'ANALYSE PAR ACTIVATION. Bibliographie Comparee. (Activation Analysis. Comparative Bibliography). Cahier d'Information du Bureau EURISOTOP 5. Serie: Bibliographies 1. Brussels, Bureau EURISOTOP - EURATOM, 1965. 46p. 60 F.B.

Five hundred articles on activation analysis were abstracted and classified according to the range of applicability, the elements determined, the interferences, the activating particles used, and other factors. The abstracts were placed on file cards together with the classification. A report giving the abstract numbers for the classification of elements determined, regions of applicability, activation particles, and country of origin is presented. (J.S.R.)

22956 URANIUM ISOTOPE ANALYSIS BY OPTICAL EMISSION SPECTROSCOPY USING THE JARRELL-ASH 3.4 METER SPECTROMETER. Leys, J. A.; Perkins, R. E. (Minnesota Mining and Mfg. Co., St. Paul). 24p. (CONF-651004-7). ORINS.

From 9th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn.

A standard Jarrell-Ash 3.4 meter convertible spectrograph-spectrometer was used for routine determination of ^{235}U, ^{236}U, and ^{238}U using the spectral lines of 4244.12, 4244.22, and 4244.37A, respectively. The method makes use of an easily constructed exit slit assembly, which optically separates the three uranium isotope spectral lines and projects them on to the photocathode surface of three photomultiplier tubes. Optical alignment of spectral lines and exit slit is continuously monitored using an argon line at 4200.68A. Photocurrents are integrated from one to two minutes, depending on the spectral source used. The integrated currents then readout sequentially. Integrated intensities are corrected for spectral background and intensity ratios calculated using ^{235}U as the internal standard in enriched samples and ^{238}U as the internal standard in natural samples. For routine analyses, a 7 amp d-c arc is used to excite a sample in the form of U_3O_8. At 5.5% concentration of ^{238}U, a coefficient of variation of 0.7% of the amount present is achieved. The coefficient of variation for ^{236}U at 0.20% concentration is about 9% of the amount present. Data are also presented using this integration technique with the plasma arc excitation source. (auth)

22957 THE CORRECTION OF INTERELEMENT EFFECTS IN X-RAY SPECTROCHEMICAL ANALYSIS. Gillieson, A. H. (Dept. of Mines and Technical Surveys,

Ottawa). 27p. (CONF-650646-2). ORINS. Gmelin, AED-CONF-65-148-3.

From American Society for Testing and Materials, 68th Annual Meeting, Lafayette, Ind.

The interelement effects on the analytical applications of x-ray fluorescence techniques are described. The characteristic secondary or fluorescent x rays produced from a given element are also absorbed by all of the elements present in their path out of the sample. Secondary x rays may, in the same manner as the primary x rays, produce characteristic tertiary x rays from all other elements in the sample on their way out of the sample. The absorption of x rays by a given element depends on the wavelength of the x rays, and on the mass absorption coefficient of the element for x rays of that wavelength. The combined effects of absorption and enhancement in binary alloy and multicomponent systems are discussed. The interelement effects in a tool steel are shown for cobalt, nickel, iron, and tungsten. The absorption curves for a binary mixture, for example, iron silicide, are shown. Mathematical treatment of the x ray results to determine the correction parameters for normal alloys or materials are discussed. (F.J.H.)

22958 ANALYSIS OF COPPER ORES IN MINE CONDITIONS BY X-RAY FLUORESCENCE INDUCED BY ISOTOPE SOURCES. Niewodniczanski, J. (Inst. of Nuclear Techniques, Krakow). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-68/10, 24p. (CONF-651023-12). ORINS.

From Symposium on Radioisotope Instruments in Industry and Geophysics, Warsaw.

The x-ray fluorescence method was used for copper content determination in copper deposits in mines. The results of laboratory investigations done in order to choose the best method of measurement and interpretation of results are described. Therefore the differential filter method was used in the measurements. The nomographic method of interpreting the results was used. In order to eliminate the influence of the varying iron contents in ores, Ni–Co filters were used. An analysis of errors in the method was carried out, taking into account the influence of the varying chemical form of copper minerals, as well as the lithological structure of rock and varying humidity. The difference between results of measurements on powdered and massive samples was also estimated. The accuracy of copper and iron determination in ores in mining conditions was estimated. Copper contents in ores (alsc those containing iron) can be determined with the accuracy of 0.3 to 0.5% Cu. The application of a ^{109}Cd source could appreciably decrease the errors. In the case of large lithological variations of copper ores, as it is the case in Polish deposits, the calibration of the apparatus should be done for each type of ore and deposits separately. (auth)

22959 IONIZATION GAS ANALYZER. Andrzej, C. (Inst. of Nuclear Research, Warsaw). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-68/16, 27p. (CONF-651023-2). ORINS.

From Symposium on Radioisotope Instruments in Industry and Geophysics, Warsaw.

Studies of ionic mobility in pure gases and mixtures of gases made it possible to analyze the composition of the gas with an accuracy attaining in some cases 0.05% of the total weight, for example, when measuring impurities in gaseous mixtures for filling ionization chambers. The apparatus used included a 6-electrode ionization chamber irradiated by an active tritium β source with titanium absorbers. The chamber is polarized by a direct current of about 1000 v and by a sinusoidal oscillation generator with a frequency varying from a few to a few hundred cycles per second. The current in this chamber at a set generator oscillation frequency depends solely on the number of ions with accurately determined mobility. The mobility is measured by determining the maximum ionization current depending on frequency. The nature of the dependence of current on frequency in a chamber constructed in this way makes it possible to carry out quantitative and qualitative analysis of the composition of the gas filling the chamber. (auth)

22960 THE GAMMA-ACTIVATION ANALYSIS OF THE COMPOSITION OF ROCK AND ORE SAMPLES. Berzin, A. K.; Sulin, V. V.; Belov, V. I.; Vitozhents, G. Ch., Martynov, Yu. T.; Suslov, V. G.; Shornikov, S. I. (All-Union Research Inst. for Nuclear Geophysics and Geochemistry, Moscow). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-68/59b, 34p. (In Russian). (CONF-651023-23). ORINS.

From Symposium on Radioisotope Instruments in Industry and Geophysics, Warsaw.

The technique, procedure, and results of recording the instrumental gamma spectra from the products of the activation by bremsstrahlung of carbon, oxygen, silicon, copper, zinc, barium, zirconium, titanium, lead, fluorine, potassium, and some other elements are discussed. The possibility of selective analysis of individual elements in a mixture is demonstrated. This is achieved by recourse to the differences in the threshold activation energy of these elements, in the shape of the instrumental gamma spectra and the half lives of their activation products. The results of applying the instrumental gamma spectra of the products of activation by betatron bremsstrahlung of samples of coal and certain ores, obtained under different irradiation and recording conditions, to the analysis of samples for certain industrially valuable elements and harmful admixtures are discussed. Data are given on the sensitivity and accuracy of gamma-activation determination of the carbon, oxygen, copper, zinc, phosphorus, fluorine, and zirconium, based on recording the gamma spectra of activation products irradiated at 15 and 30 Mev by bremsstrahlung from laboratory betatrons. (auth)

22961 X-RAY SPECTROANALYSIS USING ^{147}Pm BETA-RAY SOURCE. Tanemura, T. (Rigaku Denki Co., Tokyo); Enomoto, S. Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-68/5, 21p. (CONF-651023-18). ORINS.

From Symposium on Radioisotope Instruments in Industry and Geophysics, Warsaw.

The capability of a device for x-ray spectroanalysis using a ^{147}Pm β source was studied in comparison with β-excited x-ray source. An apparatus was constructed using a magnet between the specimen and the detector to deflect β rays scattered towards the detector. Improvements to the device are described. A source was constructed using gold, a material of high atomic number, as target in order to utilize high backscattered β rays. Be foil as thick as 100 mg/cm^2 was placed in front of the window of the proportional counter to absorb scattered β rays. An arrangement of the source, the specimen, and the counter was adopted, which can minimize β rays scattered towards the counter window. Thus, high intensity and low background were attained. Intensities of K x-ray emission from Cr, Fe, and Ni excited by the β-source were from 8 to 12 times as high as those excited by the β-excited x-ray source. Since precision of the x-ray spectroanalysis is determined by the background due to the matrix in the specimen rather than the background due to the element of interests, intensities of background were observed for materials of different atomic numbers. Intensity ratios of K x rays from Cr, Fe, and Ni to background due to matrices of low and intermediate atomic numbers bombarded by the β source were higher than or comparable to those bombarded by the β-excited x-ray source. These ratios were lower for the β source in the case of matrices of high atomic numbers. Intensity ratios of Mo K x-rays to background excited by the β source were lower than those excited by the β-excited x-ray source except for very light matrices such as paraffin. Good results were obtained in the determination of Cr and Mo in stainless steel. Accuracies of the analysis were within 0.1% (in absolute values) for Mo below 3.5% and within 0.5% for Cr from 17 to 26%. (auth)

22962 STUDIES OF THE DEVELOPMENT OF EQUIPMENT AND A METHOD FOR DETERMINING CERTAIN ELEMENTS USING RESONANCE AND THERMAL NEUTRONS. Filippov, E. M.; Zhavoronkov, V. Ya.; Vakhtin, B. S. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Vienna, International Atomic Energy Agency,

1965, Preprint No. SM-68/57, 16p. (In Russian). (CONF-651023-29). ORINS.

From Symposium on Radioisotope Instruments in Industry and Geophysics, Warsaw.

The development of equipment and a method for determining elements with high resonance slow neutron capture cross sections and elements with high thermal neutron capture cross sections in rocks are reviewed. It is shown that if rocks, ores, and ore concentrates are irradiated with fluxes of resonance neutrons from the appropriate equipment with a source of the polonium-beryllium type or similar, and if the resonance neutrons are recorded using radioactive indicators, it is, in principle, possible to determine the content of silver, gold, indium, rhenium, rhodium, rare earths, manganese, etc., in the medium in the presence of other elements. The equipment and method for the determination of boron in bedrock outcrops are described. (auth)

22963 THE DETERMINATION OF OXYGEN BY FAST NEUTRON ACTIVATION ANALYSIS. Dibbs, Hugh P. (Dept. of Mines and Technical Surveys, Ottawa). 27p. (CONF-650203-12). ORINS. Gmelin, AED-CONF-65-005-2.

From National AIME Meeting, Chicago.

An account is given of the quantitative determination of oxygen by fast neutron activation. The method, which is both rapid and nondestructive, covers a very wide range of oxygen concentrations and is almost free from matrix effects. The shielding requirements and the automatic system for sample transfer are described. Interference effects that may arise from the presence of certain elements are also discussed. (auth)

22964 ANALYSIS OF LIGHT ELEMENTS IN SURFACES BY ALPHA PARTICLE SCATTERING. Patterson, J. H. (Argonne National Lab., Ill.); Turkevich, A. L. Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-68/18, 13p. (CONF-651023-14). ORINS.

From Symposium on Radioisotope Instruments in Industry and Geophysics, Warsaw.

The dependence of the energy of a scattered alpha particle on the mass of the scattering nucleus was applied to analysis. Investigations showed that the method can be used for detection and quantitative analysis of individual elements from beryllium to calcium in the periodic table. Above calcium individual elements are not resolved, but groups of neighboring elements can be determined as a whole. Sensitivity and resolution are especially high for carbon and oxygen. Proton spectra, from nuclear reactions of alpha particles with some of the lighter elements, are easily obtained with the alpha scattering spectra. Analysis of these proton spectra can be used to improve the sensitivity and resolution of such neighboring pairs of elements as sodium–magnesium and aluminum–silicon. This method was investigated for application to remote analysis in the space program. A study was also made of its possible use in the analysis of the composition of thin films. Thicknesses of films in the micron range may be measured by analysis of the shape of the alpha scattering spectrum. Other possible applications are considered. (auth)

Inorganic and Physical Chemistry

Refer also to abstracts 22533, 23532, and 24459.

22965 (AGN-8177) ALKALI METALS EVALUATION PROGRAM. Quarterly Progress Report, October 1–December 31, 1965. Achener, P. Y.; Parr, E. D. (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AT (04-3)-368. 33p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Thermodynamic and transport properties for Cs, Rb, and K necessary for the design of space power systems using these metals as working fluids are reported. Certain thermophysical properties of alkali metals that are potential candidates as working fluids in heat pipe (capillary pump) applications are also being considered. Developments in equipment for measuring properties such as: latent heat of vaporization, vapor pressure, surface tension of the liquid in equilibrium with the vapor phase, contact angle between the liquid and the container material, liquid and vapor density, liquid and vapor viscosity, and liquid thermal conductivity for Li, Na, K, Rb, and Cs are described. (P.C.H.)

22966 (ANL-7083) THE SOLUBILITY OF METALS IN LIQUID ZINC. Johnson, Irving; Dillon, Ira G. (Argonne National Lab., Ill.). Nov. 1965. Contract W-31-109-eng-38. 116p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

The solubility data for 44 binary systems are presented in three different forms. First, the data are presented in tabular form; both the original data and smoothed data are given. Second, graphs of original data are presented with a least-squares line drawn through the points. Third, equations for the solubility as a function of temperature (based on the least-squares line) are presented. (W.L.G.)

22967 (CONF-650513-8) A STATISTICAL THERMODYNAMIC MODEL FOR NON-STOICHIOMETRIC UO_2. Aitken, E. A.; Fryxell, R. E. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Mar. 1965. Contract AT(40-1)-2847. 13p. (GE-TM-65-4-4). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Ceramic Society, Annual Meeting, Philadelphia.

A statistical model was established for UO_2 in which oxygen ions occupy either normal lattice sites or interlattice sites. The relationship between the partial molar free energy of oxygen and the composition for a given temperature was derived and applied to experimental data. The model requires the determination of four energy parameters to fit the experimental results, one of which is the Frenkel energy. A Frenkel energy of 60 Kcal/g atom of 0 was obtained using available experimental data in the oxygen excess region and some new data in the oxygen deficient region. The new data were obtained at 2400°C from free vaporization of UO_2 in atmospheres in which the oxygen partial pressure was controlled by varying the water to hydrogen ratio. The UO_2 tends toward a limiting or congruent vaporization composition which is a function of the water to hydrogen ratio in the atmosphere. (auth)

22968 (IS-1344) APPARENT MOLAL VOLUMES AND VISCOSITIES OF SOME AQUEOUS RARE-EARTH CHLORIDE SOLUTIONS AT 25 DEG C. Pikal, Michael Jon; Spedding, F. H. (Ames Lab., Iowa State Univ. of Science and Tech.). Feb. 1966. Contract W-7405-eng-82. 173p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

The specific gravities and apparent molal volumes of aqueous solutions of $PrCl_3$, $SmCl_3$, $GdCl_3$, $TbCl_3$, $DyCl_3$, $HoCl_3$, and $ErCl_3$ were determined over a concentration range of about 0.0015 to 0.18 molar. A magnetically controlled float apparatus was used to determine the specific gravities. The concentration dependence of the apparent molal volumes of these salts showed significant deviations from the simple limiting law at low concentrations. However, it was found that, except for $Nd(NO_3)_3$, these deviations are consistent with interionic attraction theory if the effect of the distance of closest approach parameter, a, is recognized. The partial molal volumes at infinite dilution, $\overline{V}_2^0$, decrease smoothly with decreasing ionic radius from La to Nd and from Tb to Yb, but from Nd to Tb the $\overline{V}_2^0$ values increase with decreasing ionic radius. This irregular behavior is discussed in terms of a gradual change in preferred water coordination number of the rare-earth ion occurring over the rare-earth ions from Nd^{3+} to Tb^{3+}. The relative viscosities of aqueous solutions of $LaCl_3$, $NdCl_3$, $SmCl_3$, $TbCl_3$, $DyCl_3$, $HoCl_3$, and $ErCl_3$ were determined at 25°C over a concentration range of about 0.05 molal to saturation at 25°C. The B coefficients of the Jones-Dole equation were also determined for these salts. The relative viscosities of several dilute $PrCl_3$ solutions were also measured to allow the B coefficient for this salt to be determined. The concentration dependence of the relative viscosity of a rare-earth chloride solution is discussed in terms of the Vand theory for large non-electrolyte molecules. The B coefficients and the relative viscosities at iso-molalities were studied as a function of

the ionic radius of the rare-earth ion, and irregularities were noted near the middle of the rare-earth series. (119 references). (P.C.H.)

22969 (JUL-Bibl.-10) NEON PHYSIKALISCHE UND PHYSIKALISCH-CHEMISCHE EIGENSCHAFTEN. EINE LITERATURZUSAMMENSTELLUNG. (Bibliography on Physical and Physicochemical Properties of Neon). Huertgen, H. (Kernforschungsanlage, Juelich (West Germany)). Aug. 1965. 41p. Dep. mn.

References (462) are given to journals, reports, and books published from approximately 1919 through 1964. An author index is included. (P.C.H.)

22970 (STI-PUB-109(Vol.1)) THERMODYNAMICS. VOL. I. Proceedings Series. Proceedings of the Symposium held in Vienna, 22-27 July 1965. (International Atomic Energy Agency, Vienna (Austria)). 1966. 536p. (CONF-650704(Vol.1)). IAEA: $11.00; S231,-; £3.6.0; F Fr 44.-; DM 38.50.

Twenty-eight papers were presented. Eighteen papers were previously abstracted in NSA; see papers under CONF-650704 in the report number index. The discussions on the sessions on calorimetry at high temperatures; EMF methods, including solid electrolytes; vaporization; and thermodynamics of the liquid state are included. (W.L.G.)

For abstracts of individual papers see: 23010-23017, 23229, and 24675.

22971 (STI-PUB-109(Vol.2)) THERMODYNAMICS. VOL. II. Proceedings Series. Proceedings of the Symposium held in Vienna, 22-27 July 1965. (International Atomic Energy Agency, Vienna (Austria)). 1966. 670p. (CONF-650704(Vol.2)). IAEA: $13.00; S273.-; £3.18.0; F Fr 52.-; DM 45.50.

Thirty-seven papers were presented. Seventeen papers were previously abstracted in NSA; see papers under CONF-650704 in the report number index. The discussions to the sessions on diffusion, correlation of thermodynamic and atomic transport properties, oxidation, pertinent recent developments in thermochemistry, and assessment of data are included. (W.L.G.)

For abstracts of individual papers see: 23018-23021, 23592, 23593, 23615-23617, 23631, 23734-23742, and 23803.

22972 (TID-22851) THE ENERGY AND ENTROPY OF VACANCY FORMATION IN BODY-CENTERED CUBIC REFRACTORY METALS. Hoch, M. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Nov. 24, 1965. Contract AT(40-1)-2847. 8p. (GE-TM-65-12-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The heat and entropy of formation of vacancies in the bcc refractory metals Cr, Nb, Mo, and W were evaluated from calorimetric data. The heat of formation data are in fair agreement with values deduced from transient specific heat techniques. The entropy of formation was much smaller (6.5 eu), than those obtained from transient techniques, giving a pre-exponential term in the expression for the concentration of vacancies, 10 times smaller. (auth)

22973 (UJV-956/63) AKTIVEROVANNYI SERNOKISLYI BARII KAK SORBENT NEBOLSHIKH KOLICHESTV. II. AKTIVIROVANIE SERNOKISLOGO BARIYA PUTEM SPEKANIYA EGO S SERNOKISLYM KALTSIEM. (Calcium-Activated Barium Sulfate as Sorbent of Radiostrontium. II. The Activation by the Heat Treatment of the Mixture of Barium and Calcium Sulfates). Berak, L.; Muenich, J. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1965. 58p. Dep. mn.

A highly selective sorbent for Sr^{2+} and Ra^{2+} based upon the forcible introduction of $CaSO_4$ flaws into the $BaSO_4$ lattice by sintering a mixture of both sulfates is proposed. Elementary problems of synthesis and strontium capture are discussed. (auth)

22974 TRISCYCLOPENTADIENYLPLUTONIUM. Baumgaertner, F.; Fischer, E. O.; Kanellakopulos, B.; Laubereau, P. (Kernforschungszentrum, Karlsruhe, Ger.). Angew. Chem. Int. Ed. Engl., 4: 878(Oct. 1965).

By treatment of plutonium with chlorine and CCl_4 at 880°C, it was possible to obtain pure, emerald-green $PuCl_3$ (isolated by sublimation), which reacted further in a melt with $Be(C_5H_5)_2$ at ~70°C. The moss-green compound formed was the first pure cyclopentadienyl complex of a transuranium element. After removal of the excess of $Be(C_5H_5)_2$ by sublimation, the cyclopentadienyl compound was isolated in more than 60% yield in a high vacuum at 140 to 165°C on a water-cooled finger. The product was free from chloride ions and extremely sensitive to air. It was attacked by argon-saturated water with evolution of gas, and by air-free N HCl or by 18% nitric acid with formation of a blue solution of Pu^{3+}. The compound remained unchanged for weeks at room temperature under an inert gas; it began to sinter at 180°C and decomposed above 195°C. Infrared spectra showed the presence of symmetrical five-membered rings (characteristic bands at 779/793 cm^{-1}(γCH), 841 cm^{-1}, 1007 cm^{-1} (δCH), 1447 cm^{-1} (ωCC), and 3100 cm^{-1} (νCH)). From the positions and intensities of the bands, as well as the absence of appreciable absorption at 1100 cm^{-1}, it was concluded that the linkage between the metal and the cyclopentadienyl ligands had strong ionic character. (BBB)

22975 CONTRIBUTION TO THE STUDY OF A GROUP OF ISOSTRUCTURAL SULFIDES OF RARE EARTHS AND YTTRIUM OF THE TYPE Y_5S_7 AND FeY_4S_7. Adolphe, Claude (Univ., Paris). Ann. Chim. (Paris), 10: 271-97(May-June 1965). (In French).

Compounds of the type Y_5S_7 were prepared by heating Y_2S_3 at 1550°C under vacuum, or by heating a mixture of the metal and Y_2S_3 at 1350°C under vacuum. Compounds of the type FeY_4S_7 were prepared by heating a mixture of Fe and $2Y_2S_3$ at 1100°C in a stream of H_2S, followed by heating in a sealed tube at 1200°C; this technique was not applicable to $FeYb_4S_7$. Compounds of the type MnY_4S_7 were prepared by heating a mixture of MnS and $2Y_2S_3$ in a sealed tube to 1200°C; this technique was not applicable to $MnDy_4S_7$ or $MnYb_4S_7$. A crystallographic study was performed on single crystals of Y_5S_7 and FeY_4S_7; the compounds are isotypic. The crystal structure is monoclinic face centered, space group C2/m. In Y_5S_7 the Y atoms are six- and seven-coordinate, and the S atoms five- and four-coordinate; the latter valences are tetrahedral or in the same plane. In FeY_4S_7 Fe replaces Y randomly. The compounds are paramagnetic; trivalent ions are present, with no other valence state (except Fe^{+2} in FeY_4S_7). The compounds Y_5S_7 are conductors, while FeY_4S_7 are not. (BBB)

22976 STABILITY OF TRITIUM-METAL COMPOUNDS USED AS TARGETS IN FAST NEUTRON GENERATORS. Breynat, G.; Dubus, M.; Gerbier, R.; Maurin, J.-F. (CEN, Grenoble, France). Bull. Inform. Sci. Tech. (Paris), No. 98, 81-92(Nov. 1965). (In French).

Studies of absorption kinetics for tritium on erbium and yttrium layers and of erbium-hydrogen system stability were done with a view to making targets for 14-Mev neutron production with deutron accelerators. The behavior of Ti and Er targets was experimentally examined using a 400-kev electrostatic accelerator. The results confirmed a better stability regarding temperature of erbium targets, but an important improvement in the target half life did not result. This seemed due to target sputtering by the deuteron beam. (auth)

22977 SYNTHESIS OF XENON DIFLUORIDE BY EXPOSURE OF XENON-FLUORINE MIXTURES TO DAYLIGHT AT ROOM TEMPERATURE. Holloway, John H. (Univ. of Aberdeen, Scotland). Chem. Commun., No. 1, 22(Jan. 12, 1966).

The preparation of xenon difluoride from xenon and fluorine in Pyrex glass vessels at 25°C is described. When the mixtures were subjected to diffuse daylight or sunlight colorless crystals formed on the inner surface of the vessels. Infrared and mass-spectrometric analyses made on the vapor phase showed peaks and fragmentation patterns characteristic of xenon difluoride. Chemical analysis confirmed the spectrometric evidence. Similar xenon-fluorine mixtures, which were kept in darkness for 4 months did not

produce XeF_2. The same mixtures, after exposure to daylight for 24 hr deposited xenon difluoride crystals. (F.J.H.)

22978 EFFECT OF HYDROGEN - DEUTERIUM ISOTOPIC SUBSTITUTION ON THE INTENSITY OF INFRARED ABSORPTION BANDS. Jouve, Pierre (Laboratoire de Spectroscopie Hertzienne, Paris). Compt. Rend., Ser. C, 262: 441-3(Feb. 7, 1966). (In French).

Isotopic substitution causes variations of frequency and intensity in infrared absorption bands. B. Crawford and A. D. Buchingham showed theoretically that the parameter $\Sigma A/\mu^2$ for the fundamental and $A_n/n^{\mu(n+1)}$ for the harmonic n^{μ} are invariant during this substitution. These theoretical results were verified experimentally for HCl, HC ≡ CH, and $CH_3-C\equiv CH$. The parameter A/μ^2 represents the electron environment around the proton and is the reason that it can be connected to nuclear magnetic resonance data. (tr-auth)

22979 DIRECT MEASUREMENT AT 1100°C OF THE SPECIFIC ENTHALPIES OF THE OXYGEN IN THE OXIDES UO_{2-x} IN THE VICINITY OF UO_2. Gerdanian, Paul; Dode, Maurice (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. C, 262: 798-9(Mar. 7, 1966). (In French).

When O/U increases, the specific enthalpy of oxygen, decreases strongly beginning with very high values, passes through a very marked minimum at O/U = 2.0018, and then slowly increases in a linear fashion beginning at O/U = 2.01. (tr-auth)

22980 URANYL COMPLEXES WITH PHENOLIC LIGANDS. V. POTENTIOMETRIC ANALYSIS OF THE COMPLEXES WITH 2,3-DIHYDROXYNAPHTHALENE-6-SULFO ACID, CHROMOTROPIC AND KOJIC ACIDS, PYROCATECHIN, RESORCINOL, AND PHENOL. Bartusek, M.; Ruzickova, J. (Purkyne-Univ., Brno). Collect. Czech. Chem. Commun., 31: 207-21(Jan. 1966). (In German).

Complex formation in approximately 10^{-3} M uranyl(VI) salt solutions in the presence of ligand excess was investigated potentiometrically and the step-wise formation of single nuclear complexes and of protonized complexes was detected. Only the slightly stable complexes with phenol and resorcinol underwent, in the pH range from 4 to 5, hydrolysis with the formation of hydrolytic multi-nuclear complexes. (tr-auth)

22981 CONTRIBUTION TO THE STUDY OF PROTACTINIUM OXALATE. Muxart, Roland; Guillaumont, Robert; Vernois, Jacques (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. C, 262: 888-9(Mar. 14, 1966). (In French).

The composition of protactinium oxalate precipitated by the addition of hydrochloric acid to a protactiniferous oxalic solution was determined. The most probable formula proposed is $PaO(C_2O_4)OH \cdot x H_2O$ with $x = 2$ or perhaps 1.5. (tr-auth)

22982 URANYL ION–ITACONIC ACID COMPLEX. Ramamoorthy, S.; Santappa, M. (Univ. of Madras). Curr. Sci. (India), 35: 145-6(Mar. 20, 1966).

Studies showed that the uranyl ion-itaconic acid complex is formed in the 1:1 ratio and the stability constant K_1 = 4.849 from $\bar{n}$ (formation function) vs-log A plot and K_1 = 4.9 ± 0.05 from calculation. In the pH range, 2.2–3.5 and for concentrations of metal ions, 3.2×10^{-3} and 1.6×10^{-3} M, $\bar{n}$ values do not go beyond 0.4 and 0.3, respectively, and K_1 calculated at these concentrations are 4.58 and 4.73, respectively. It was concluded that the trend of K_1 values with changes in concentrations of metal ion ligand does not warrant any decision with regard to polymerization of the complexes. (P.C.H.)

22983 CHLORINATION OF TANTALUM CARBIDE AND NIOBIUM CARBIDE. Saeki, Yuzo; Omori, Goro (Inst. of Metallic Material Technic, Tokyo). Electrochemistry, 31: 410-14(1963). (In Japanese).

The formation of tantalum tetrachloride and niobium tetrachloride by the chlorination of tantalum carbide and niobium carbide was observed from the point of view of thermodynamics. The chlorination reactions proceed as follows: $2\ TaC + 5\ Cl_2 \rightleftharpoons 2\ TaCl_5 + 2\ C$ and $2\ NbC + 5\ Cl_2 \rightleftharpoons 2\ NbCl_5 + 2\ C$. These reactions can proceed easily thermodynamically and ΔF^0 decreases with increase of temperature. In the reaction $C + 2\ Cl_2 \rightleftharpoons CCl_4$, equilibrium favors CCl_4 formation at temperatures below 488°C and decomposition of CCl_4 above 488°C. The reaction leading to chlorination of tantalum carbide and niobium carbide was determined by the hot-balance method. In this experiment, 0.4942 g tantalum carbide and 0.4936 g niobium carbide were individually placed in the reaction tubes. The air in the tube was replaced by argon; then, argon was replaced by dry chlorine gas. The rate of addition of chlorine gas to the tube was 60 ml/min. The increase in temperature was regulated at 2.7°C/min, and the weight change during the reaction at various times was measured. The reaction of tantalum carbide with chlorine started at a temperature of about 280°C and the chlorination of niobium started at about 250°C. In both cases the reaction proceeded rapidly at the temperatures above 400°C. (BBB)

22984 ON THE THERMAL DECOMPOSITION OF SOME URANIUM SALTS OF ORGANIC ACIDS. Lyden, Ragnar (Univ. of Helsinki). Finska Kemistsamfundets Medd., 74: 37-44(1965). (In German).

The uranyl salts of formic, oxalic, and mesoxalic acid, and $U(C_2O_4)_2 \cdot 6H_2O$ were heated in a CO_2 stream and were decomposed to a uranium oxide. Analysis of the lower uranium oxides was carried out gravimetrically by precipitation of Au from $HAuCl_4$. Uranyl formate monohydrate lost water at 170 to 180°C and darkened at 310°C to give U_3O_8, CO, CO_2, and H_2O. Uranyl oxalate trihydrate lost water at 160 to 170°C, and darkened at 305 to 310°C to give a dark oxide with a blue iridescence corresponding to U_3O_7, which reacted with air at room temperature slowly; CO and CO_2 were also formed. The mesoxalate salt, prepared by solution of uranic acid in aqueous mesoxalic acid by warming and evaporation at room temperature, lost water at 145 to 150°C and turned dark at 290°C. Gas evolution in the other cases was contemporaneous with darkening, but here it occurred only after the temperature reached 300°C; the oxide was dark brown and sensitive to air, and corresponded to UO_2; CO and CO_2 were side products. The decomposition of U(IV) oxalate hexahydrate began with loss of water at 160 to 180°C and darkening to give brown, pyrophoric UO_2 at 305 to 310°C with evolution of gas. (BBB)

22985 ASTATINE AND ITS CHEMICAL PROPERTIES. Qiao, Ming-lun. Hua Hsueh Tung Pao, No. 7, 48-52(1965). (In Chinese).

Chemical aspects of At are reviewed. A natural product of decay in both the U and Th series, At occurs in the earth's crust by an amount estimated to be 6.86×10^{-2} g. Half lives of the isotopes range from 2×10^{-6} sec (^{214}At) to 8.3 hr (^{210}At). Chemical properties resemble those of I; the redox potential declines in the order Cl–Br–I–At, but At^{+5} has strong oxidizing properties. Astatine evaporates 16 times more readily in glass than in Au; it evaporates more easily from reducing than oxidizing solutions. Extraction from alkaline solution with CCl_4 and C_6H_6 gives partition coefficients of 0.85 and 1.5, respectively; the low values are due to disproportionation to ionic species in basic solution. Its halogen compounds have high polarity; it precipitates at both negative and Pt electrodes. It coprecipitates with AgI, TlI, and PbI_2; reacts with H_2; is similar in elemental form to Po in that it forms halogen compounds. Positive At precipitates with HgS in 6N HCl; it can be separated from absorptive precipitation with sulfides of Bi, Sb, Hg, and Ag by adjusting the pH. Purification by sublimation and precipitation is discussed. It is absorbed by the thyroid and ^{211}At might be used in place of ^{131}I in treatment of hyperthyroidism. (53 references) (BBB)

22986 FLUORIDE COMPLEXES OF URANIUM (IV). THE PREPARATION OF FLUOROURANIUM (IV) SULFATES. Stein, Lawrence; Williams, Clayton W.; Fox, Irene M.; Gebert, Elizabeth (Argonne National Lab., Ill.). Inorg. Chem., 5: 662-5(Apr. 1966).

Uranium(IV) is strongly complexed by fluoride in aqueous solutions, forming the cations UF^{3+}, UF_2^{2+}, UF_3^{+}. Spectral bands at 430, 485, 494, 549, 652, and 1130 mμ diminish

greatly in intensity on the addition of HF to solutions of $U(SO_4)_2$; other bands are affected to a lesser degree. Perchlorate and sulfate solutions containing chiefly UF_2^{2+} exhibit spectra with vibrational fine structure in the region of 400 to 650 mμ analogous to spectra of the oxygenated ions UO_2^{2+}, NpO_2^{2+}, NpO_2^{+}, and PuO_2^{2+}. Intervals of approximately 400 cm^{-1} between several bands are ascribed to the symmetric uranium–fluorine vibration of UF_2^{2+} in excited electronic states. The complex salts $UFSO_4(HSO_4) \cdot 2H_2O$, $UF_2SO_4 \cdot 2H_2O$, and $(UF_2)_2SO_4 \cdot 4H_2O$ were obtained by precipitation from aqueous and mixed aqueous–organic solutions. Infrared spectra and x-ray powder patterns of several phases are reported. (auth)

22987 PREPARATION OF MF_6.NaF COMPLEXES WITH URANIUM, TUNGSTEN, AND MOLYBDENUM HEXAFLUORIDES. Katz, Sidney (Oak Ridge National Lab., Tenn.). Inorg. Chem., 5: 666-8(Apr. 1966). (ORNL-P-1728).

The hexafluorides of uranium, tungsten, and molybdenum react with sodium fluoride to reach 1:2 and 1:1 stoichiometric ratios with unexpected speed when the sodium fluoride is formed by decomposition of $UF_6 \cdot 2NaF$. The equilibrium pressures of the 1:1 complexes for the reaction $2(MF_6 \cdot NaF) \rightleftharpoons MF_6 + MF_6 2NaF$ are: for UF_6, $\log P_{mm} = 11.06 \pm 0.02 - (3.48 \times 10^3)/T$; for WF_6, $\log P_{mm} = 7.05 \pm 0.02 + (1.99 \times 10^3)/T$; and for MoF_6, $\log P_{mm} = 7.29 \pm 0.03 - (1.83 \times 10^3)/T$. (auth)

22988 MAGNETIC PROPERTIES OF PRASEODYMIUM SELENIDES. Chechernikov, V. I.; Pechennikov, A. V.; Yarembash, E. I.; Kalitin, V. I. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 2138-9 (Dec. 1965). (In Russian).

The magnetic properties of the selenides PrSe, Pr_3Se_4, Pr_2Se_3, and Pr_3Se_7 were studied. The magnetic susceptibility was measured in the 80 to 800°K range. Above room temperature, the measurements were made in a 10^{-4} mm Hg vacuum to prevent oxidation. Curves were obtained for reciprocal magnetic susceptibility versus temperature. The Curie-Weiss law $X = C/(T - \theta_p)$ was obeyed by all the samples. If the paramagnetic Curie point θ_p was determined from the experimental data, and the effective atomic magnetic moment P_p was then calculated, it was found that these values change in proportion to the praseodymium content. The magnetic moments corresponded to the magnetic moment of Pr^{3+} ion, i.e., 3.3μB. The Curie point θ_p was positive in Pr_3Se_4, Pr_2Se_3, and Pr_3Se_7, and negative in PrSe and $PrSe_2$; this was due to the appearance of antiferromagnetic interaction in the latter two compounds. It was concluded that the magnetic properties of praseodymium selenides are chiefly determined by the 4f electrons, which are in a localized state. (ATD)

22989 STUDY OF THE COMPOSITION AND STRUCTURE OF LANTHANUM AND CERIUM TRIFLUORIDE CRYSTAL HYDRATES. Luk'yanychev, Yu. A.; Baturina, E. A.; Malyuchkov, O. T. (Inst. of Steel and Alloys, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 2182-8(Dec. 1965). (In Russian).

Lanthanum and cerium trifluoride crystal hydrates were precipitated from hydrochloric and nitric acid solutions by adding 40% hydrofluoric acid. Chemical analysis showed the composition of the crystal hydrates to be $LaF_3 \cdot (0.8$ to $0.5)H_2O$ and $CeF_3 \cdot (0.5$ to $0.3H_2O)$. Nuclear magnetic resonance, x-ray phase analysis, and infrared methods showed that the hydrates have a lattice similar to the anhydrous salts. The water molecules entering into the composition of the crystal hydrate are located in the vacancies of the lattice and form hydrogen bonds of the type F ... H–O of different configurations. The presence of water molecules in the lattice appreciably affects the mobility of fluorine atoms. X-ray phase analysis, NMR, and thermographic and thermogravimetric methods established that the removal of water molecules occurs gradually in $LaF_3 \cdot 0.5H_2O$, at 60 to 80 and 80 to 225°C; in $CeF_3 \cdot 0.5H_2O$, at 60 to 80, 80 to 360, and 380 to 450°C. The structure of phases dehydrated below 225°C remains unchanged, and on further heating the compound changes from a metastable to a stable state; this transition is associated with a change in the position of the fluorine atoms. (ATD)

22990 GROWTH OF EUROPOUS OXIDE (EuO) SINGLE CRYSTALS. Guerci, C. F.; Shafer, M. W. (IBM Watson Research Center, Yorktown Heights, N. Y.). Contract AF 49(638)-1230. J. Appl. Phys., 37: 1406-7(Mar. 1, 1966).

The desirability of having large-sound single crystals of EuO for a number of physical measurements has been well established. Although crystals of EuO had previously been grown, they were either of poor quality, primarily because of container contamination, or too small for many measurements. A method of growing large, single-phase, mechanically sound crystals of EuO is reported. The method is one where growth takes place from a solution containing an excess of europium metal. The solution, sealed in molybdenum crucibles, is cooled from 1950°–2000°C at the rate of about 25°/h. Centimeter-size crystals were grown and shown to be of extremely good quality by an examination of their Laue spots and their microstructure. The crystals have a lattice constant of 5.1451 Å ± 0.0003 and a density of 8.180 ± 0.002. The data from the crystal-growing experiments were used to propose a phase diagram in which EuO, when pure, is shown to be an incongruently melting compound. (auth)

22991 CONDUCTANCE STUDY OF ANHYDROUS RARE EARTH BROMIDES DISSOLVED IN METHANOL. Johnston, David O.; Harrell, Jack B. Jr. (David Lipscomb Coll., Nashville). J. Chem. Eng. Data, 11: 251-2(Apr. 1966).

Conductance data are reported for methanol solutions of anhydrous bromides of La, Pr, Sm, Gd, Co, Er, and Yb at 20 and 45°C. For the series, the molar conductances show a maximum at Gd. (P.C.H.)

22992 COVALENCY EFFECTS IN U^{4+} HALIDE COMPLEXES. Johnston, D. R.; Satten, R. A.; Schreiber, C. L.; Wong, E. Y. (Univ. of California, Los Angeles). J. Chem. Phys., 44: 3141-3(Apr. 15, 1966).

Experimental and calculated electronic energy levels of Cs_2UBr_6 and Cs_2UCl_6 are reported. The shift from the Cs_2UCl_6 levels due to the change in crystal-field parameters alone and to the change in the free-ion parameters alone is calculated and is tabulated along with the energy levels. It is noted that, although the free-ion parameters decrease as the covalency increases as expected, the crystal-field parameters are also found to decrease exponentially. (L.B.S.)

22993 SOME OCTAHEDRAL COMPLEXES OF URANIUM(IV). Day, J. P.; Venanzi, L. M. (Inorganic Chemistry Lab., Oxford). J. Chem. Soc., Sect. A, No. 2, 197-200 (1966).

The electronic spectra and magnetic susceptibilities of the complexes $[UCl_6]^{2-}$, $[UCl_4Br_2]^{2-}$, $[UBr_6]^{2-}$, $[UCl_4(Ph_3PO)_2]$, $[UCl_4(Et_3PO)_2]$, and $[UBr_4(Ph_3PO)_2]$ were measured. Relative values for the nephelauxetic effects, and the ligand fields, of the ligands were derived. The possibility of spin-pairing in uranium(IV) is discussed and shown to be unlikely. (auth)

22994 FLUORO COMPLEXES OF QUINQUEVALENT PROTACTINIUM. Brown, D.; Easey, J. F. (Atomic Energy Research Establishment, Harwell, Eng.). J. Chem. Soc., Sect. A, No. 3, 254-8(1966).

The preparation, from aqueous hydrofluoric acid solution, of anhydrous heptafluoroprotactinates(V), M_2PaF_7 (M = K, NH_4, Rb, and Cs), and of lithium and sodium octafluoroprotactinates(V), M_3PaF_8, is described. Octafluoro-complexes containing larger cations (M = K and Cs) were prepared by heating together the appropriate alkali-metal fluoride and the heptafluoro-complex in an inert atmosphere. The preparation of hexafluoro-complexes from aqueous hydrofluoric acid is discussed, and some chemical properties, x-ray diffraction data, and infrared spectra are reported for the three classes of compounds. (auth)

22995 PHOSPHINE OXIDE COMPLEXES OF PROTACTINIUM, NIOBIUM, AND TANTALUM PENTACHLORIDES. Brown, D.; Easey, J. F.; du Preez, J. G. H. (Atomic Energy Research Establishment, Harwell, Eng.). J. Chem. Soc., Sect. A, No. 3, 258-61(1966).

Phosphine oxide complexes of protactinium, niobium, and

tantalum pentachloride. $MCl_5.R_3PO$[M = Pa. Nb. and Ta; R = C_6H_5 and $N(CH_3)_2$] and $MCl_5.R_2R'PO$(M = Pa and Ta: R = C_6H_5; R′ = $C_6H_5 \cdot CH_2$). were prepared in anhydrous methyl cyanide and methylene dichloride. Niobium(V). but not protactinium (V), forms an oxychlorocomplex. $NbOCl_3.2(C_6H_5)_3PO$ in the presence of an excess of triphenylphosphine oxide. Some chemical properties. infrared spectra. and x-ray powder diffraction data are reported. (auth)

22996 PROTACTINIUM(V) BROMIDES. Brown, D.; Jones, P. J. (Atomic Energy Research Establishment, Harwell, Eng.). J. Chem. Soc., Sect. A, No. 3, 262-4 (1966).

The preparation of protactinium pentabromide. $PaBr_5$. from the pentoxide was investigated. The most satisfactory method was found to be the reaction between bromine vapor and a mixture of protactinium pentoxide and carbon at 600 to 700°C, in a sealed evacuated vessel. The yellow-green oxytribromide. $PaOBr_3$. obtained as a by-product of this reaction, was more conveniently prepared by the action of oxygen on the pentabromide at 350°C. The oxytribromide disproportionated at 500°C in a vacuum. to give the pentabromide and the white dioxybromide PaO_2Br. Some chemical properties. infrared spectra. and x-ray powder diffraction data are reported for these bromides. (auth)

22997 INFORMATION ON THE HIGH-TEMPERATURE MODIFICATION OF COMPOUNDS OF THE TYPE Me^1XO_4 (Me = Cs. Tl; X = Re, Tc, Cl). Kanellakopulos. B. (Gesellschaft fuer Kernforschung mbH. Karlsruhe. Ger.). J. Inorg. Nucl. Chem.. 28: 813-16(Mar. 1966). (In German).

The perchlorates. perrhenates. and pertechnetates Me^1XO_4 of cesium and thallium possess a second modification at higher temperature with cubic (X = Cl) or tetragonal (X = Re, Tc) structure. The Tc compounds have a lower transition temperature than the Re compounds. (auth)

22998 PREPARATION AND SOLUBILITIES OF SCANDIUM AND LANTHANIDE LACTATES. Gouveia, M. A.; De Carvalho, R. G. (Junta de Energia Nuclear, Lisbon). J. Inorg. Nucl. Chem., 28: 913-14(Mar. 1966).

Lanthanide lactates and scandium lactate were prepared and their composition and solubility were studied. An excess of lanthanide oxide was refluxed for 16 hr in a reflux condenser with 2M lactic acid. After removal of excess oxide a 1:2 mixture of ethanol–ethyl ether was used to separate the lactate from the solution. Lactates of the heavier lanthanides prepared by this method were identical to those obtained by crystallization from concentrated solutions. All lactates were white except for Pr(green). Nd(lilac). and Er(rose). Analytical data on the lactates of La. Nd. Sm. and Sc dried over concentrated H_2SO_4 are given. The solubility data of lactates of Er. La. Nd. Pr. Sc, and Tb in water at 20 and 60° after 8 days of contact are given. (F.J.H.)

22999 PREPARATION OF PLUTONIUM PHOSPHIDE BY DIRECT COMBINATION OF THE ELEMENTS. Moser, J. B.; Kruger, O. L. (Argonne National Lab., Ill.). J. Less-Common Metals, 10: 402-7(June 1966).

The preparation of plutonium phosphide by reaction of plutonium metal with phosphorus was carried out in a tantalum-lined stainless steel pressure vessel. Constant external pressure was maintained on the vessel during the heating and cooling cycle by means of spring loading. The reaction product was characterized by means of x-ray diffraction and metallographic examination and chemical analysis. (auth)

23000 KINETICS OF THE REACTION OF URANIUM MONOCARBIDE WITH WATER. Colby, L. J. Jr. (Atomics International, Canoga Park, Calif.). J. Less-Common Metals, 10: 425-31(June 1966).

The rate of hydrolysis of uranium carbide from 30 to 86.2°C was measured by a constant-volume technique. An activation energy of 17.6 kcal/mole of UC was obtained from an Arrhenius plot of the data. The hydrolysis-reaction rate at 70°C was found to be proportional to the square root of the water concentration when 2-propanol was used as a diluent. It is, therefore, postulated that the rate-determining step in the hydrolysis of uranium carbide involves the breaking of an O–H bond. (auth)

23001 RELATIONS AMONG VIBRATIONAL FREQUENCIES OF ISOTOPICALLY SUBSTITUTED MOLECULES AND THE DETERMINATION OF FORCE CONSTANTS. II. THE ONE-DIMENSIONAL CASE. Heicklen, Julian (Aerospace Corp., El Segundo, Calif.). J. Phys. Chem., 70: 989-91 (Apr. 1966).

Some relations among vibrational frequencies exist in addition to those previously described for the special case in which only one Cartesian coordinate of any atom is involved in the motion. This situation applies for all motions of linear molecules and the out-of-plane motions of planar molecules. There are $m(m-1)/2$ relations, in addition to the product rules, among the vibrational frequencies of m + 1 isotopic molecules, in which nonequivalent atoms are substituted. (auth)

23002 MECHANISM OF ADDITION OF TRITIUM TO OLEATE BY EXPOSURE TO TRITIUM GAS. Peng, C. T. (Univ. of California, San Francisco). J. Phys. Chem., 70: 1297-1304(Apr. 1966).

Formation of tritiostearate by exposure of oleate to tritium gas proceeds by a mixed radical and ion-molecule mechanism with 40% of the total addition caused by tritium atoms and 60% by ion molecules containing tritium. Argon sensitizes the addition by the formation of tritium argonium ion, ArT^+, and oxygen inhibits the reaction by scavenging both radicals and ions. Gross tritium incorporation in the reactant is temperature dependent, which is interpreted as the result of an equilibrium between tritium in the adsorbed phase and that in the gas phase. Labeling by tritium at cryogenic temperature is mainly decay induced. The activation energy for tritiation by addition is higher than by substitution and is of the same order of magnitude as those observed for addition of hydrogen atoms to unsaturates by others. (auth)

23003 RESEARCH IN THE RARE EARTH OXIDE-BERYLLIUM OXIDE SYSTEMS. I. PHASE EQUILIBRIUM IN THE La_2O_3-BeO SYSTEM. Kuo, Chu-k'un; Yen, Tungsheng. Kuei Suan Yen Hsueh Pao, 4: 82-9(1965).

The phase equilibrium relationship of the La_2O_3-BeO system was studied. Samples were prepared by calcining 99% lanthanum oxide and beryllium oxide at 1200°C for 4 hr and at 1300°C for an additional 4 hr. Temperatures between the liquidus line and solidus line were determined by the quenching method. Phases were determined by the polarizing microscopic method and x-ray powder method. Two binary compounds were identified. The regions of 3 phase coexistence in the system are BeO–$La_2O_3 \cdot 2BeO$-liquid. $La_2O_3 \cdot 2BeO$–$3La_2O_3 \cdot 2BeO$-liquid. and $3La_2O_3 \cdot 2BeO$–La_2O_3-liquid. The respective invariant points of the system were found to be 1356 ± 2°C, 40.8 mol % $LaO_{1.5}$; 1362 ± 4°C. 51 mol % $LaO_{1.5}$; and 1510 ± 10°C. 66 mol % $LaO_{1.5}$. BeO appears in the form of hexagonal crystal ($n_0 = 1.718 \pm 0.002$. $n_e = 1.733 \pm 0.005$); La_2O_3 in hexagonal slab ($n_0 = 2.047$); $La_2O_3 \cdot 2BeO$ in orthorhombic crystal ($n_0 = 1.980 \pm 0.006$. $n_y = 2.035 \pm 0.01$); and $3La_2O_3 \cdot 2BeO$ in hexagonal crystal ($n_0 = 2.055 \pm 0.01$. $n_e = 2.030 \pm 0.006$). Pure glass with a refractive index of 1.95 can be obtained by quenching the sample containing 40 to 52.9% $LaO_{1.5}$ at temperatures above the liquidus line. Comparison of the La_2O_3–BeO system with the corresponding silicate and borate systems showed that lanthanum beryllate can be formed in the system. Lanthanum beryllate exhibits low stability and high dissociation resulting from the low strength of the Be–O bonding. (CFSTI)

23004 CATALYTIC GRAFT COPOLYMERIZATION ONTO POLYVINYL CHLORIDE. Kimura, Fujiko; Fujiwara, Keiko; Sakurada, Ichiro. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 67-74(1964-1965). (In Japanese).

Catalytic graft copolymerizations of vinyl monomers to polyvinyl chloride powder were carried out in sealed glass ampoules at 60°C in vacuo and in air. Styrene, acrylonitrile, and vinyl acetate were used as monomers, and the graftings were studied by using the pure monomers and monomer solutions. Among the monomers used, styrene was grafted most easily and α,α′-azoisobutyronitrile was very effective as a catalyst compared with benzoyl peroxide and potassium persulfate. The grafting rate in vacuo

was higher than in air. The grafting of styrene proceeded smoothly without induction period both in vacuo and in air, and the graft copolymer could be obtained with good graft efficiency, almost independent of compositions of the monomer solutions and ratios of monomers to polyvinyl chloride. The presence of methanol in the monomer mixtures was observed to accelerate the grafting. The rate of grafting to fiber was higher than that to powder, and in the case of the grafting of styrene, the highest percent grafts observed in the experiments were about 150 for fiber and 60 for powder, respectively. (auth)

23005 THERMAL EXPANSION OF SOME SULFIDES OF TRANSITION METALS. Dudnik, E. M.; Oganesyan, V. Kh. Porosh. Met., Akad. Nauk Ukr. SSR, No. 2, 60-2 (Feb. 1966). (In Russian).

Measurements of the thermal expansion coefficients of sulfides are discussed. An estimate is given of their elastic constants, characteristic temperatures, and mean square amplitudes of elastic oscillations. (auth)

23006 STUDIES ON URANYL COMPLEXES. I. URANYL COMPLEXES OF EGTA. Silva, J. J. R. Frausto da; Simoes, M. Lourdes Sadler (Centro de Estudos de Quimica Nuclear (I.A.C.), Lisbon). Rev. Port. Quim. (Lisbon), 7: 137-44(1965).

The uranyl complexes of EGTA, (ethyleneglycol-bis-aminoethylether)tetraacetic acid, were studied by potentiometric and absorptiometric methods. Evidence is presented for the formation in solution of the species $UO_2(H_2O)HY^-$, $(UO_2)_2(H_2O_2)_2Y$, $(UO_2)(HO)HY^{2-}$, $(UO_2)_2(HO)(H_2O)Y^-$, $(UO_2)_2(HO)_2Y^{2-}$; their respective formation constants were determined by potentiometric measurements. The species $Na(UO_2)(H_2O)HY$ and $(UO_2)_2(H_2O)_2Y$ were isolated in solid form: infrared spectra gave evidence for considerable covalent character in uranium–oxygen bonds and supported the formulation of the complexes with coordinated water and free carboxylate groups. (auth)

23007 BEHAVIOR OF MICROAMOUNTS OF ZIRCONIUM IN THE PRESENCE OF PHENYLARSENIC ACID IN A MEDIUM OF 2N HNO_3. Kyrs, M.; Pistek, P.; Selucky, P. (Czechoslovak Academy of Science, Rez). pp 45-73 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.1]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenka Akademie Ved [1965].

In a medium of 2N HNO_3 zirconium traces have the properties of a radiocolloid: high sorption, independence of type and amount of sorbent in a broad range, and sedimentation after centrifugation. This radiocolloidal effect is explained by the sorption of zirconium traces on a certain portion of polymeric particles of benzenearsonic acid. (auth)

23008 STUDY OF STABILITY OF COMPLEXES OF RHODANINE WITH SILVER, Cu, AND Tl BY EXTRACTION METHODS. Navratil, O. (Univ., Brno). pp 104-10 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.1]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965]. (In Czech).

Complexes of rhodanine and 5-substituted derivatives with Ag, Cu, and Tl were investigated radiometrically. It is shown that Ag forms stable chelate complexes of the AgA and the AgA_2-type in weakly acid media; the stability constants of both types are of the same order. Copper, in weakly acid media, forms only complexes of the CuA type. In the system Tl–p-dimethylaminobenzylidenerhodanine, the complex formed only in strongly alkaline solutions. The stability and structure of the complexes are discussed. (tr-auth)

23009 POWDER METALLURGY METHOD FOR PREPARATION OF RADIOACTIVE α AND β SOURCES. Benadik, Anton (UVVVR, Prague). pp 146-55 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.1]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965]. (In Czech).

Techniques for the preparation of sealed sources using powder metallurgy methods are reported. Emphasis was placed on initial powder mixtures of silver with $^{90}SrCO_3$, $^{204}Tl_2O_3$, $^{144}CeO_2$, $^{147}Pm_2O_3$, ^{106}Ru, $^{226}RaCO_3$, $^{239}PuO_2$, and a number of additional radioisotopic compounds with α and β decay. Sealed plane sources were prepared from active powders using compacting, sintering, and rolling techniques. Several encapsulating methods with radioactive sources were tested. Of these methods the direct compacting procedure of sandwiched powder proved valid. After the powder compacts were sintered and rolled down, sandwiched high activity strips were obtained. These featured activity firmly bonded within the metal and were protected by an outer coating of silver 3 to 100 μ in thickness. Other shapes such as plates or discs can also be made from the basic foil by cutting. (auth)

23010 CALORIMETRY AT HIGH TEMPERATURES. Groenvold, F. (Univ. of Oslo). pp 35-52 of STI-PUB-109(Vol.1).

Reliable data for the thermal behavior of substances, and for the reactions between them, are required at increasingly higher temperatures both for fundamental and practical purposes. Calorimetry affords the most direct, and in several cases the only way of procuring such data with sufficient accuracy. The recent developments in calorimeters for heat-capacity, heat of transition and heat of reaction, solution and mixing studies at high temperatures ($\geq$250°C) are reviewed. Some consideration is given to the choice of constructional materials for calorimeters, to measurement of temperature and energy, and to the control of the temperature of the closest surroundings, that is shields and thermostat. For heat-capacity studies a considerable number of calorimeters have been described during the last ten years. The majority of them operate below 500°C, with accuracies varying from ±5 to ±0.1%. Calorimeters for use above 1000°C are rare, and the temperature limit seems at present to be 1700°C. The thermal characteristics of higher-order transitions are preferably studied in calorimeters with adiabatic shield. First-order transitions, fusion and precipitation are studied also in more or less elaborate calorimeters with an isothermal shield. High-temperature reaction calorimeters have been developed considerably in the same period, and the accuracies improved from about ±5 to ±0.5% in the 500°C region. One main line of application has been in the determination of heats of mixing for liquid alloys, and in solution calorimetry within liquid metals. For such uses the operating range has been extended to 1100°C. Heats of reaction between solids and corrosive gases have been determined at 775°C, and heats of reaction between solid components determined up to 1400°C with reasonable accuracy. (auth)

23011 HEATS OF MIXING IN BINARY SYSTEMS OF MOLTEN SALTS. Murgulescu, I. G.; Marchidan, D. I. (Inst. of Chemical Physics, Bucharest). pp 67-73 of STI-PUB-109(Vol.1). (In French).

The heat of mixing is an important thermodynamic property in binary mixtures. As a result of the recent development of high-temperature calorimetry, the heat of mixing in binary systems of molten salts can be determined directly. The results of thermochemical measurements on the (Rb–K)Cl; (Rb–Na)Cl; (Ag–Na)Cl; (Na–K)Br; and (Br–Cl)Na systems at different concentrations and temperatures are presented. The most significant components of the heat of mixing are the ionic contribution and the polarization energy of the ions. Consequently, use could be made of a relation of the form: $\Delta H^M = Q_i - Q_p$. The heat of mixing can then have either positive or negative values depending on the sign and the preponderance of the Q_i and Q_p energies. (auth)

23012 USE OF A VACUUM CALORIMETER TO MEASURE THE HEATS OF DISSOLUTION OF Ge, Al AND Ag IN Sn AT 700 DEG C; ENTHALPY MEASUREMENTS ON Sn, ZrB_2, TiB_2, BN AND B_4C. Mathieu, J.-C.; Durand, F.; Bonnier, E. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France). pp 75-88 of STI-PUB-109(Vol.1). (In French).

The calorimeter employed was similar in principle to that used by Kleppa and was designed to operate at temperatures of 700°C or above. It was made of nickel and consisted of an oven and a system of damping screens

at high vacuum. The thermogram is registered directly in numerical form; then, taking the heat loss to obey Newton's Law, the temperature-time results are evaluated on a computer to give the heat released in the particular experiment. The apparatus is calibrated using synthetic sapphires from the National Bureau of Standards. The apparatus, designed for the measurement of heats of dissociation, also permits of enthalpy determination: the authors have measured that of tin at 700°C, a value which has so far always been extrapolated, as well as those of ZrB_2, TiB_2, BN and B_4C between 300 and 750°C. Then, with regard to alloy formation, measurements were made on the heat of dissolution of silver, germanium and aluminum in tin at 700°C. In the last-mentioned system, the measurements supplement, for low aluminum concentrations, the EMF measurements by Massart. (auth)

23013 THE EMF METHOD IN STUDYING THERMODYNAMIC AND KINETIC PROPERTIES OF COMPOUNDS AT ELEVATED TEMPERATURES. Schmalzried, H. (Max-Planck-Institut fuer Physikalische Chemie, Goettingen, Ger.). pp 97-109 of STI-PUB-109(Vol.1).

After a brief historical outline on the use of solid electrolytes in high temperature electrochemistry, expressions for the EMF of mixed ionic plus electronic electrolytes are given. A number of electrolytes and their limits of applicability are discussed. Examples of the use of solid electrolytes in the field of thermodynamics are presented, namely investigations on the free energy of formation of binary and ternary compounds, and the thermodynamics of binary alloys and binary ionic crystals with a broad homogeneity range. Examples in the field of kinetics are the studies of the phase boundary reaction during oxidation of metals, diffusion of oxygen in metals, nucleation of metals during reduction of oxides of sulfides, and polarization studies. (auth)

23014 THERMODYNAMIC PROPERTIES OF ALLOYS OF IRON AND SILICON. Vecher, R. A.; Geiderikh, V. A.; Gerasimov, Ya. I. (Moscow State Univ.). pp 171-80 of STI-PUB-109(Vol.1). (In Russian).

The Fe–Si phase diagram is complex. At 1000°K there are $FeSi_2(\beta)$ and FeSi phases and solid solutions of silicon in α and α' iron. EMF measurements were made on the electrochemical cells: $Fe|Fe^{2+}$, KI + NaI|Fe–Si at 600–800°C. The alloys were prepared from particularly pure components by powder metallurgy and protracted annealing. Studies were made of ten alloys with silicon content between 85 and 4% in all the phase fields in the diagram section at 1000°K. The integral thermodynamic quantities ΔG, ΔH, and ΔS were calculated for the formation of the silicides $FeSi_2(\beta)$, FeSi, and Fe_3Si at the mean temperature for the experimental range (1000°K), and also (using the thermal capacity of the silicides, the iron and the silicon) at 298, 1188, and 1798°K. The heats of formation of the silicides mentioned at 298°K (kcal/mole) are –19.4, –17.6, and –22.4 respectively. The data existing in the literature enabled the calculation of the heat of formation of $FeSi_{2.33}$ (α-leboite) at 298°K and this is found to be –14.4 kcal/mole. The heats calculated are 1.5–3 kcal higher than the experimental values of Corber and Olsen. The heats of mixing calculated for liquid alloys agree well with data in the literature. The data obtained can be regarded as due to the change in the character of the bond in silicides from metallic to covalent when the silicon content is increased. From the data for alloy solutions of silicon in α-iron, the iron activities were calculated. It was found that the $\alpha \rightleftharpoons \alpha'$ transformation observed is a real phase transformation. The two-phase range is wider than shown in the phase diagram (from data in the literature). Conversion of the iron activities in solid solution to liquid solution gives good agreement with the data of Chipman. (auth)

23015 THE EVAPORATION BEHAVIOUR, THERMODYNAMIC PROPERTIES AND SYSTEMATIC TRENDS OF ACTINIDE METAL–OXYGEN SYSTEMS. Ackermann, R. J.; Thorn, R. J. (Argonne National Lab., Ill.). pp 243-69 of STI-PUB-109(Vol.1).

Mass effusion measurements and mass spectrometric observations were combined with existing calorimetric and recent EMF data to yield a consistent thermodynamic description of actinide metal–oxygen systems. Any meaningful description of the evaporation behavior of a given condensed phase must include a careful specification of either the partial pressure of oxygen in the system or the composition of the condensed phase because all of the solid dioxide phases, for example, exhibit bivariant behavior due to variation in composition. The solid stoichiometric dioxides increase in total vapor pressure in the somewhat inverted order, ThO_2, PuO_2, NpO_2, and UO_2, and in each case the gaseous dioxide is the predominant vapor species. The ease of reduction in vacuum of these phases increases with increasing atomic number giving rise to a MO_{2-x} phase and/or metal in the case of Th and U, and to lower oxides in the case of Np and Pu. Reduction of a given dioxide results in an increase of the total vapor pressure due to the rapid increase of the gaseous monoxide which becomes the major vapor species. This behavior is at present most completely resolved in the case of the U–O system. There are two significant systematic trends involving the vapor phase: the gaseous dioxides (plus 4 valence states of metal) become less stable (ΔG_f° becomes more positive) with increasing atomic number, and the gaseous monoxides (plus 2 valence states of metal) become more stable with increasing atomic number. Other correlations and comparisons of the thermodynamic properties in the solid, vapor and solvated phases of actinide metals and compounds are made with those of lanthanide metals and compounds. The trends in the former case are generally more complex as a result of the more pronounced dual nature of the actinides as transition elements with d-electrons and rare earth elements with f-electrons. (auth)

23016 VAPOUR PRESSURES AND MOLECULAR ASSOCIATION OF THE VAPOURS OF MOLTEN POTASSIUM CHLORIDE AND BROMIDE. Murgulescu, I. G.; Marta, Letitia (Inst. of Chemical Physics, Bucharest). pp 345-58 of STI-PUB-109(Vol.1). (In French).

A new technique for determining vapor pressures by the transport method is presented. This method is applied to pure, molten KCl and KBr. Using transport data obtained previously, and knowing the vapor pressures, which had been determined by a static method, the average molecular weight of the vapors was calculated. From mass-spectrometric, magnetic resonance, and velocity distribution studies on a molecular cluster of alkali halides, it is known that the vapors of KCl and KBr are composed exclusively of monomers and dimers. It was thus possible to calculate the molar fractions of the monomer and the dimer in equilibrium with the liquid from the average molecular weight obtained experimentally, using a relation of the following type: $\overline{M} = x_1M + 2x_2M$ where $\overline{M}$ is the average molecular weight of the vapors, x_1 and x_2 are the molar fractions of the monomer and the dimer, and M is the molecular weight of the monomer. Knowing the molar fractions of the monomer and the dimer for the vapors of KCl and KBr, the partial pressure and heat of vaporization were calculated as well as the dissociation constant and the heat of dissociation of the dimer. (auth)

23017 VAPOUR PRESSURE OF URANIUM MONOCARBIDE. Khromonozhkin, V. V.; Andrievskii, R. A. (Inst. of Power Engineering, Obninsk, USSR). pp 359-66 of STI-PUB-109(Vol.1). (In Russian).

The partial vapor pressures of U and C over UC were studied in the temperature range 1900–2400°K by a differential Knudsen method. The following equations were obtained for the temperature dependences of the vapor pressures (mm Hg): $\log p_U = 10.054 - (2.809 \times 10^4/T)$, $\log p_C = 2.515 - (1.324 \times 10^4/T)$. The partial heat of sublimation of U ($\Delta \overline{H}_{298}$) assessed by the second- and third-law methods was 132.6 and 123 kcal/mole respectively. Up to a temperature of ~2100°K mainly C atoms vaporized, and above this temperature U atoms. (auth)

23018 RECENT DEVELOPMENTS IN THE CHEMICAL THERMODYNAMICS OF THE URANIUM CHALCOGENIDES. Westrum, E. F. Jr. (Univ. of Michigan, Ann Arbor). pp 497-510 of STI-PUB-109(Vol.2).

Extension of the cryothermal data on U_4O_9 to higher temperatures revealed the thermophysical aspects of the (suspected) gradual, λ-type structural transition at 348°K with an associated entropy increment of 1.84 cal/gfm°K involved in the displacement of interstitial oxygen atoms. Measurements of both heat capacity and magnetic susceptibility on Mallinckrodt sintered UO_2 confirmed that the antiferromagnetic-paramagnetic transition occurs at 30.4°K with a heat capacity of 400 cal/gfm°K rather than at 28.7°K with 9 cal/gfm°K as reported in the literature. This now permits interpretation of the thermal anomaly found in β-U_3O_8. Cryogenic heat capacities on well-characterized samples of α-, β- and γ-UO_3 are combined with his higher temperature heat capacities, enthalpies of formation and other thermodynamic data to yield relative stability data for these important nuclear materials. Both USe and USe_2 are found to have lambda-type anomalies associated with magnetic disordering. That in USe_2 occurs at 13.1°K with an associated entropy increment of 0.16 cal/gfm°K. The 160°K anomaly in USe has an entropy increment of 1.0 cal/gfm°K, which may be compared with the value of 1.17 found for the monosulfide near 180°K. Both thermal anomalies in the monochalcogenides arise as a consequence of disordering the ferromagnetic state and contrast with the antiferromagnetic anomaly found in the isostructural mononitride at 52°K. The new thermodynamic data accord well with the entropy estimation scheme of Gronvold and Westrum. (auth)

23019 THE HEAT OF SOLUTION OF PLUTONIUM IN HYDROCHLORIC ACID. Akhachinskii, V. V. (Moscow State Univ.). pp 561-70 of STI-PUB-109(Vol.2). (In Russian).

The following values for the heat of solution of plutonium in 6 M hydrochloric acid have been given in four works published to date: −141.64 ± 0.2 kcal/mole, −141.02 ± 0.19 kcal/mole, −141.14 ± 0.14 kcal/mole and −138.90 ± 0.9 kcal/mole. The authors of the last of these works consider their value to be the correct one, but perusal of all the cited works shows that one cannot give a clear preference to their result. The result of a new determination of the heat of solution of alpha plutonium in 6 M hydrochloric acid is presented. A value of −141.5 ± 0.4 kcal/mole is found, allowance being made for the impurities in the plutonium. The close agreement between this value and the first three cited above casts doubt on the fourth result and it is therefore essential that the values given for the heats of formation of $PuCl_3$, PuOCl, and the Pu^{3+} ion be recalculated. (auth)

23020 THE CRITICAL ASSESSMENT OF THE PHYSICOCHEMICAL PROPERTIES OF SUBSTANCES. Kubaschewski, O. (National Physical Lab., Teddington, Eng.). pp 583-96 of STI-PUB-109(Vol.2).

For the application of physiochemical values to practical and theoretical problems, it becomes increasingly important that the published experimental data should continuously be sifted and critically assessed by experts. This type of work is actually a relatively new field in chemistry, and some of the principles and methods involved in assessing the thermodynamic and transport properties of metallic substances are discussed. The centers dealing with this evaluation work, their distribution, and their accepted responsibilities are outlined. (auth)

23021 REFERENCE PUBLICATIONS BEING PREPARED IN THE SOVIET UNION ON THE THERMODYNAMIC PROPERTIES OF SUBSTANCES. Glushko, V. P.; Gurevich, L. V.; Medvedev, V. A. (Inst. of High Temperatures, USSR Academy of Sciences, Moscow). pp 597-601 of STI-PUB-109(Vol.2). (In Russian).

In 1956 and 1962 two editions of the handbook "Thermodynamic Properties of Substances" were published in the Soviet Union. The second edition of this book gave data on the properties of 335 substances over a wide temperature range. At the present time supplements to the book are being prepared dealing with the properties of several hundred more substances and, on the basis of new studies and calculations, giving more precise details on the properties of the substances included in the previous editions. The first supplement, which will be published in 1965, will contain data on a number of transition metals (Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W) and their oxides. The following supplement will deal with compounds of alkali metals. A handbook entitled "Thermal Constants of Substances" is also being prepared giving heats and free energies of formation, dissociation energies, entropies and other properties at 0 and 298.15°K; phase transition temperatures and heats and critical parameters for all the inorganic and the simplest organic substances studied are also given. The first parts of this book will appear in 1965, dealing with oxygen, hydrogen and its isotopes, halogens, noble gases, elements of the sulfur and nitrogen groups, and compounds formed between these elements. The two handbooks represent a co-ordinated system of critically selected quantities. (auth)

23022 PAPER ELECTROPHORETIC STUDY OF THE FORMATION OF COMPLEX COMPOUNDS OF EUROPIUM, PROMETHIUM, AMERICIUM, AND CURIUM IN A TARTARIC ACID MEDIUM. Marcu, Gheorghe; Samochocka, Krystyna (Univ., Warsaw). Stud. Univ. Babes-Bolyai, Ser. Chem., 10: No. 2, 71-7(1965). (In Rumanian).

The isotopes ^{152}Eu, ^{147}Pm, ^{241}Am, and ^{246}Cm were studied in a tartaric acid medium of approximately 0.041M by paper electrophoresis. The electrophoretic mobilities of the compounds were established for different pH values at a potential difference of 925 v. The stability constants were determined for the compounds $(EuTart_2)^-$, $(PmTart_2)^-$, $(AmTart_2)^-$, and $(CmTart_2)^-$. The values of these constants are $\lg \beta_{2(Cu)} = 6.21$, $\lg \beta_{2(Pm)} = 5.81$, $\lg \beta_{2(Am)} = 7.88$, and $\lg \beta_{2(Cm)} = 7.40$. The behavior of promethium and curium was very similar to that of europium and americium, respectively, which led to the supposition of the existence in the solution of ions of the form $(PmTart_2)^-$ and $(CmTart_2)^-$. The nonstability constants were calculated as $K_{Eu} = 1.62 \times 10^{-8}$, $K_{Pm} = 6.49 \times 10^{-7}$, $K_{Am} = 6.32 \times 10^{-9}$, and $K_{Cm} = 2.51 \times 10^{-9}$. (tr-auth)

23023 HYDROGEN ISOTOPE EXCHANGE REACTIONS OF NONBENZENOID AROMATICS. I. ON THE H–D EXCHANGE BETWEEN AZULENE AND PYRROLIDINE-D. Weiss, C. (Karl-Marx-Univ., Leipzig). Tetrahedron, 22: 145-56(Jan. 1966). (In German).

The kinetics of deuterium exchange between azulene and pyrrolidine-d were studied in sealed tubes at 200°C. Pseudo first-order rate constants for various H atoms in azulene were found to be 3.4×10^{-4} sec^{-1} for H−1 and H−3, 1.9×10^{-5} sec^{-1} for H−2, and 6.0×10^{-7} sec^{-1} as an average value for all H atoms of the seven-membered ring. The exchange reaction is first order in azulene concentration and second order in pyrrolidine concentration; a mechanism consistent with these observations is proposed. Studies of deuteration of 1,3-dimethylazulene and 2-methylazulene were also incorporated into these determinations; in these cases ir studies indicated that no D was incorporated in the methyl groups. Kinetic data were tabulated and graphed for all compounds examined. (BBB)

23024 ISOTOPE EFFECTS AND THE RELATIVE REACTIVITY OF HYDROGEN ATTACHED TO CARBON AND NITROGEN IN ETHYLENEIMINE. Gray, Peter; Jones, A. (Univ. of Leeds, Eng.). Trans. Faraday Soc., 61: 2161-7(Oct. 1965).

The abstraction of hydrogen from ethyleneimine and ethyleneimine-d_1 was studied to determine the position of radical attack, the primary isotope effect in N−H and N−D bonds, and the influence of structure on reactivity of methylene and amine groups in cyclic and acyclic compounds. The abstraction by methyl radicals was studied over the temperature range from 110 to 175°C, using azomethane as the radical source. Hydrogen abstraction occurred at both the methylene and amine sites; the rate of abstraction being much greater from the N−H bond. Arrhenius parameters (based on a value of $10^{13.34}$ cm^3 mole^{-1} sec^{-1} for the recombination of methyl radicals) were derived for the reactions involved. When photolysis of azomethane was carried out in the presence of unlabeled ethyleneimine, additional methane was formed

by attack on both methylene and amine groups in the molecule. When the photolysis of azomethane was carried out in the presence of ethyleneimine-d_1 the products observed and analyzed quantitatively were CH_4, CH_3D-N_2, and C_2H_6. These products were accounted for by adding two reactions to the previous scheme proposed for azomethane photolysis. At 150°C, hydrogen attached to nitrogen was abstracted nearly 40 times more readily than hydrogen attached to carbon, and on a per-atom basis was thus about 160 times more reactive. This was compared with previous experiments with deuterated amines, in all of which the hydrogen attached to nitrogen was found, at 150°C, to be the more reactive. On a per-atom basis, the relative reactivity of amine-hydrogen in CH_3NH_2, $(CH_3)_2NH$, and CH_3ONH_2 was 3.4, 20, and >75, respectively. At 150°C, hydrogen was abstracted twice as fast from the NH group in ethyleneimine as from the NH group in dimethylamine. At 150°C, hydrogen was abstracted 8 times as fast from ethyleneimine as deuterium was from ethyleneimine-d_1. The isotope effect was wholly accounted for by the increase in activation energy, 1.7 ± 0.5 kcal mole^{-1}, which could, in turn, be compared with the loss of zero-point energy of a single N–H stretching vibration of 1.3 kcal mole^{-1}. These results agreed within experimental error with other observed primary isotope effects where hydrogen and deuterium were abstracted from nitrogen bonds. (BBB)

23025 HYDROGEN AND DEUTERIUM ATOM ABSTRACTION FROM METHANOL AND TRIDEUTEROMETHANOL. REACTION OF METHOXY RADICALS WITH METHANE. Shaw, R.; Thynne, J. C. J. (Univ. of Edinburgh). Trans. Faraday Soc., 62: 104-11(Jan. 1966).

The reactions of trideuteromethyl radicals with methanol and trideuteromethanol were studied in order to determine the position and rate of hydrogen and deuterium atom abstraction. Over the temperature range studied (130–250°C) the rate of abstraction from the methyl and hydroxyl groups is similar. Substitution of deuterium for hydrogen alters the positional reactivity by an amount in agreement with zero-point energy difference. Rate constants at 182°C and Arrhenius parameters (based on a value of $10^{13.34}$ mole^{-1} cm^3 sec^{-1} for the recombination rate constant of methyl radicals) measured for reactions are given and were calculated for $CH_3O\cdot + CH_4 \rightarrow CH_3OH + CH_3$. (auth)

23026 ON THE SOLUBILITY OF OXIDES AND CARBONATES OF RARE EARTH ELEMENTS, YTTRIUM, AND SCANDIUM IN COMPLEXONE III SOLUTIONS. Stolyarov, K. P.; Vinogradova, N. I. Vestn. Leningr. Univ., No. 16, Ser. Fiz. Khim., No. 3, 96-100(1965). (In Russian).

The solubility of rare earth, Y, and Sc oxides and carbonates in sodium ethylenediaminotetraacetate solutions was investigated at 25–90°C, and dissolution schemes are suggested. (auth)

23027 LOSS OF MERCURY AND ITS PREVENTION IN MEASUREMENT OF RADIOACTIVE MERCURIC SALTS. Tanaka, Yoshimasa; Kitahara, Kazuta; Yoshida, Yoko (Kumamoto Univ., Japan). Yakugaku Zasshi, 84: 687-90 (1964). (In Japanese).

It was found that a large amount of ^{203}Hg is lost when the aqueous solution of radiomercury salt is evaporated to dryness in a sample dish for measurement of its radioactivity. Effects of the kind of mercury salts on the loss of mercury was examined for nitrates, sulfates, chlorides, hydroxides, and sulfides. Various reagents were added to the solution of of mercury nitrate, the solution was evaporated to dryness, and radioactivity (cpm) of the residue was measured to determine the effect of such an agent in preventing the loss of mercury. It was found that ammonium sulfide and sodium diethyldithiocarbamate are effective in such inhibition. Ammonium sulfide addition stopped the loss completely but its use seemed inconvenient. Combined use of sodium sulfide and ammonium chloride had the same effect. Diethyldithiocarbamate was convenient for use but its power to stop the loss of ^{203}Hg was inadequate. (BBB)

23028 STABILITY AND LIGAND EXCHANGE RATE OF HEXACHLORO- AND HEXABROMO COMPLEXES OF TECHNETIUM(IV) AND RHENIUM(IV). Schwochau, Klaus (Kernforschungsanlage, Juelich, Ger. Univ., Cologne). Z. Naturforsch., 20a: 1286-9(Oct. 1965). (In German).

The complex formation constants and the ligand exchange velocities of hexachloro- and hexabromotechnetate(IV) and rhenate(IV) were determined under comparable conditions. The formation constants K_6 obtained for $(TcCl_6)^{2-}$ and $(TcBr_6)^{2-}$ were $^1/_{50}$ as large as the corresponding Re complexes. The exchange rates of the chloro- and bromotechnetates measured with ^{36}Cl and ^{82}Br are almost 20 or 50 times as high as that of the analogous Re compounds. The activation energies of the exchange reactions were determined. (tr-auth)

23029 SCALAR NUCLEUS-ELECTRON EXCHANGE BETWEEN DIFFERENT MOLECULES IN SOLUTIONS. Mueller-Warmuth, W. (Max-Planck-Institut fuer Chemie, Mainz). Z. Naturforsch., 21a: 153-7(Jan.-Feb. 1966). (In German).

The dynamic polarization of the ^{19}F nuclei in free radical solutions of C_6F_6, C_6H_5F, and $C_6H_4F_2$ is much less negative than expected from investigations of the proton polarization in similar systems. In the limits of "extreme narrowing" the enhancement factor is of the order of –100 instead of –350; in strong magnetic fields it is even positive. Data obtained in fields of 16.2, 176, and 3230 gauss are interpreted in terms of a combined dipole-dipole and scalar coupling between nuclear and electron spins. For the time dependence of the dipolar interaction the model of an independent "translational" random diffusion of spin-carrying molecules is used whilst the scalar interaction is described by a spectral function proportional to $\tau Sk/(1 + \omega^2\tau Sk^2)$. The results are compared with measurements of Richards in strong magnetic fields and with theoretical models of Hubbard for the scalar interaction. Diffusional and scalar correlation times, the relative contribution of the scalar interaction and the order of the coupling constant are calculated. (auth)

23030 CARBOTHERMAL REDUCTION OF HIGHER URANIUM OXIDES IN THE PRESENCE OF ALKALI METAL CARBONATE IMPURITIES. Tkachenko, E. V.; Vlasov, V. G.; Semavin, Yu. N. Zh. Prikl. Khim., 38: 1447-51(July 1965). (In Russian).

During investigation of the effects of carbonate impurities on the kinetics of the carbothermal reduction of amorphous uranium trioxide at 460°C and uranium–uranous oxide at 700°C, it was established that the impurities have an accelerating effect on the reduction of uranium–uranous oxide and that this effect increases in the series K_2CO_3–Na_2CO_3–Li_2CO_3. It is shown that in the primary stages of the process the carbonate impurities increase the reduction of the uranium trioxide. Potassium carbonate retards the process, sodium carbonate does not affect it, and lithium carbonate accelerates it. A study of the mechanism of the impurity effects showed the possibility of two supplementary processes: dissociation of the carbonate to the metal oxide and carbon dioxide and interaction of the carbonates with uranium oxide and subsequent formation of the corresponding uranates. (tr-auth)

23031 RAMAN SPECTRA OF SOLUTIONS OF URANYL COMPOUNDS. Volodko, L. V.; Sabilo, K. V. Zh. Prikl. Spektrosk., 4: 52-7(Jan. 1966). (In Russian).

In connection with doubts expressed previously as to whether the frequency of 200 cm^{-1} should be assigned only to deformation vibrations of the ion UO_2^{++}, Raman spectrum lines of aqueous and organic solutions of nitrate, acetate, chloride and sulfate of uranyl are compared in the 150–1000 cm^{-1} region. In addition to vibration frequencies of molecules of solvents symmetrical deformation vibration of the nitrate ion appears in the spectra at 750 cm^{-1}, a symmetrical valence vibration of the uranyl ion at 860 cm^{-1}, and a frequency of about 200 cm^{-1}. An analysis of the possible alternative assignment of the latter shows that it can belong only to deformation vibrations of the uranyl ion, whose activity in the Raman spectrum is due to the structure of complex uranyl compounds. (auth)

23032 PROCEEDINGS OF THE SYMPOSIUM ON COORDINATION CHEMISTRY, TIHANY, HUNGARY, 1964.

Beck, Mihaly T. (ed.). Akademiai Kiado, Budapest, 1965. 484p. (CONF-640928).

Forty papers presented at the Tihany Symposium and the discussions are collected. The topics covered are the chemistry of polynuclear, mixed ligand and outer-sphere complexes and catalytic phenomena in coordination chemistry. Separate abstracts were prepared for 8 papers. (M.C.G.)

For abstracts of individual papers see: 23033–23038, 23062, and 23228.

23033 ELECTRON TRANSFER SPECTRA OF LANTHANIDES AND 5f GROUP COMPLEXES—HOW TO DISTINGUISH OUTER-SPHERE, ANISOTROPIC AND NORMAL ANION COMPLEXES. Joergensen, C. K. (Cyanamid European Research Inst., Cologny-Geneva). pp 11-21 of Proceedings of the Symposium on Coordination Chemistry. Beck, Mihaly T. (ed.). Budapest, Akademiai Kiado, 1965.

The wave numbers of the electron transfer bands are to a first approximation proportional to the difference between the electronegativity of the most reducing ligand and of the central atom. However, these wave numbers are larger than their normal values in anisotropic complexes such as formed by copper(II) and uranium(VI) as well as in outer-sphere complexes and ion-pairs. In the latter cases, the band intensities are far smaller. Samarium(III), europium(III), ytterbium(III), and neptunium (IV) complexes are used as examples. (auth)

23034 STRUCTURE AND SOME REACTIONS OF URANYL-ACETYLACETONE COMPLEXES. Szoeke, J. (Central Research Inst. for Physics, Hungarian Academy of Sciences, Budapest). pp 107-22 of Proceedings of the Symposium on Coordination Chemistry. Beck, Mihaly T. (ed.). Budapest, Akademiai Kiado, 1965.

Investigations on uranyl–acetylacetone complexes are reported. It was found that the hydrated uranyl ion combines with acetylacetone (Acac) to form a metastable uranyl-bis-acetylacetone-dihydrate complex and to form a stable uranyl-bis-acetylacetone-monohydrate. The uranyl-bis-Acac-hydrates and their thermal decomposition products dissolve in acetylacetone and yield a monomeric uranyl-bis-Acac-HAcac complex. When boiled in acetylacetone, this complex combines to uranyl-tris-Acac of symmetrical structure. These complex compounds were prepared and investigated by spectroscopy and derivatography. The experimental data give further support to the structural model of the uranyl ion: an octahedron with coordination number 6 proposed previously. (auth)

23035 STABILITIES OF POLYNUCLEAR AND MIXED LIGAND CHELATES OF TRI- AND TETRAPOSITIVE METAL IONS. Martell, A. E. (Illinois Inst. of Tech., Chicago). Contracts AT(30-1)-1823; AT(11-1)-102s. pp 164-73 of Proceedings of the Symposium on Coordination Chemistry. Beck, Mihaly T. (ed.). Budapest, Akademiai Kiado, 1965.

Equilibria involving the formation of polynuclear complexes of Fe(III), Th(IV), Zr(IV), and VO(IV) through olation reactions are described. The conditions for this type of polymerization were examined and compared with systems in which polynuclear complex formation occurs through bridging by donor groups of the ligand. Mixed ligand chelate compounds were considered from the point of view of the blocking of hydroxo metal complex formation (hydrolysis), and preventing formation of polynuclear complexes by combination of the original mononuclear complex with a second ligand. Mixed ligand chelates are described in which a bidentate ligand combines with Th(IV) chelates of ethylenediaminetetraacetic acid, N-hydroxyethylethylenediaminetriacetic acid, and trans-1,2-cyclohexanediaminetetraacetic acid. (auth)

23036 ON EQUILIBRIA IN THE AQUEOUS SOLUTION OF THE Nd(III)-d-GLUCOSAMINIC ACID SYSTEM. Gergely, A.; Gyoeri, B. (Kossuth Lajos Univ., Debrecen, Hungary). pp 175-85 of Proceedings of the Symposium on Coordination Chemistry. Beck, Mihaly T. (ed.). Budapest, Akademiai Kiado, 1965.

Equilibria of the Nd(III)–d-glucosaminic acid system were studied in the range between 5×10^{-3} to 10^{-2}M Nd(III) concentration, at Nd(III): d-glucosaminic acid ratios between 1:0.5 and 1:10. Under such conditions, the presence of four complexes in equilibrium with one another was detected by means of pH-metric, conductometric and photometric measurements. The type of complex formed predominantly depended on the pH and NaOH concentration. Between pH 6 to 7 $Nd(H_3G)^{2+}$(I) and $Nd(H_3G)(OH)^{+}$(II)$^{+}$ were formed. Depending on the total concentration of Nd(III) and d-glucosaminic acid, between pH 7.0 and 8.5 mainly binuclear complexes were present, namely: $Nd_2(H_3G)(OH)_2^{3+}$(III) and $Nd_2(H_3G)(OH)_4^{+}$(IV). Based on pH-metric data, the corresponding stability and equilibrium constants were calculated. These are as follow: for I: $K_1 = 2.70 \cdot 10^2$, for II: $K_h = 1.43 \cdot 10^{-7}$, and for III: $K_3 = 5.92 \cdot 10^8$. (auth)

23037 INFRARED STUDIES ON POLYMERIC METAL ETHOXIDES. Bradley, D. C.; Westlake, A. H. (Univ. of Western Ontario, London, Canada). pp 309-15 of Proceedings of the Symposium on Coordination Chemistry. Beck, Mihaly T. (ed.). Budapest, Akademiai Kiado, 1965.

The infrared absorption spectra of $Al(OEt)_3$, $Ti(OEt)_4$, $Zr(OEt)_4$, $Hf(OEt)_4$, $Nb(OEt)_5$, $Ta(OEt)_5$, $U(OEt)_5$, and $U(OEt)_6$ were determined either in carbon disulfide solution or as Nujol mulls. Assignments of bands to terminal and bridging ethoxide groups were made for C–O and M–O bonds. The approximate relative intensities of terminal to bridging C–O bands are discussed qualitatively in terms of possible structures for these polynuclear complexes. (auth)

23038 THE ACCELERATION OF THE URANIUM(IV)-(VI) EXCHANGE REACTION BY TARTARIC ACID. Benson, E. P. Jr.; Brubaker, C. H. Jr. (Michigan State Univ., East Lansing). pp 427-35 of Proceedings of the Symposium on Coordination Chemistry. Beck, Mihaly T. (ed.). Budapest, Akademiai Kiado, 1965.

The effects of several organic acids on the exchange reaction between uranium(IV) and uranium(VI) were studied in perchloric acid–sodium perchlorate solutions of ionic strength = 2.0 M. All of the acids were found to accelerate the reaction with the effect decreasing in the order tartaric ≫ malic > maleic > malonic. (auth)

23039 PHYSISORPTION AND CHEMISORPTION OF WATER BY NUCLEAR GRAPHITE. Lang, F. M.; Magnier, P.; Valle, C.; Cazard, J. 10p. (CONF-650632-9) ORINS. Gmelin, AED-CONF-65-149-2.

From 7th Biennial Conference on Carbon, Cleveland.

The behavior of graphite with respect to moisture in atmospheric gases was studied. The storage space for graphite was kept between relative humidity values such that P/Ps lies between 0.3 and 0.8. The adsorption isotherm on nuclear graphite at 20°C showed that at P/Ps = 0.8 graphite can adsorb about 80 ppM of water. When the product was purified at higher temperatures the adsorption was lower. Above room temperature the water was no longer physisorbed but chemisorption occurred. The use of dry argon and damp argon in degassing graphite is discussed. The chemisorbed water can desorb in three regions between 50 and 600°C. At higher temperature the water is desorbed in the form of CO and H_2. (F.J.H.)

23040 METHOD FOR REMOVING RADIOACTIVE SUBSTANCES IN WATER. Kurita, Haruo (to Kurita Industrial Co., Ltd.). Japanese Patent 1964-11560. June 9, 1965. Filed Aug. 24, 1962.

A new method for simultaneously removing radioactive ions and colloidal substances from water employs an alkali-treated clay of a double-layer structure and another alkali-treated clay of a triple-layer structure. It was found that a clay, treated with a heated alkaline substance, of a double-layer structure (e.g., Kaoline or Halloysite) adsorbed selectively divalent radioactive ions (e.g., ^{90}Sr), and that a heated-alkali treated clay of a triple-layer structure (e.g., Montmorillonite or Vermiculite) adsorbed selectively monovalent radioactive ions (e.g., ^{137}Cs). (NSA of Japan)

23041 APPARATUS FOR REPLACING THE DEPLETED ION-EXCHANGE RESIN IN A NUCLEAR POWERED SHIP. Seto, Shoji (to Nippon Atomic Industrial Group Co., Ltd.). Japanese Patent 1964-11922. June 14, 1965. Filed Feb. 20, 1962.

The apparatus proposed includes the following: an ion-exchange desalting device in the nuclear ship; a facility outside the ship in which are contained a depleted-resin storage tank, a new- or regenerated-resin storage tank, a water tank for transferring the resin, and a pump for the water; and two pipes connecting the ship and the facility. By circulating the water through the desalting device in the ship and the depleted resin tank, the depleted resin in the desalting device is discharged into the tank. In a similar manner the new resin in the facility is sent into the desalting device from its tank. (TCO)

Organic Chemistry

23042 (EUR-2170.d) MESSUNG DER DAMPFDRUCKE VON HOCHSIEDENDEN UND-SCHMELZENDEN ORGANISCHEN STOFFEN MITTELS EINES ISOTENISKOPS. (Measurement of Vapor Pressures of High-Boiling and Melting Organic Substances by Means of an Isoteniscope). Luhleich, H.; Hodapp, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1964. 14p. Dep. mn.

A new type of isoteniscope is described for measuring the vapor pressure of high-boiling and -melting substances by means of the static method. Gallium is used as sealing liquid. This apparatus was used to measure o- and p-terphenyl vapor pressures up to about 5000 mm Hg. (auth)

23043 (EUR-2713.e) MASS SPECTROMETRIC STUDIES ON POLYPHENYLS. PART II. THE MASS SPECTRA OF THE TRIPHENYLBENZENES AND TRIPHENYLENE. Facchetti, S.; Copet, A.; Beyrich, W. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1966. 20p. Dep. mn.

The 70 and 50 ev mass spectra of the three triphenylbenzenes and triphenylene, obtained with an Atlas CH4 Mass Spectrometer, are reported and discussed. As observed for some polyphenyls previously studied, the ortho bonded molecules are characterized by a lower stability under electron impact leading to a greater fragmentation by rupture of C–H and C–C bonds. Triphenylene behaves like other condensed aromatic hydrocarbons showing a higher stability and a specific fragmentation. From their mass spectra, previsions are made on gas formation in the radiolysis of these molecules. (auth)

23044 (MIT-905-52, pp 74-94) ORGANIC ISOTOPE APPLICATIONS GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Results of investigations concerning reactions of triphenylmethyl chloride in benzene are summarized. Research on the ionizing power of tetra-n-hexylammonium benzoate, enolization of ketones by bases, decomposition of benzenediazonium ions, solvation of t-butyl cations, isotope effects in benzoyl chloride hydrolysis, cation activity in H_2SO_4-water mixtures, free radical reactions, generation of radical ions, and decay of nitroalkane anions in dimethylformamide at –50°C. (J.R.D.)

23045 RADIOACTIVE LABELING OF TROPANE ALKALOIDS. IV. SYNTHETIC INCORPORATION OF ^{14}C IN (–)-SCOPOLAMINE, SCOPINE, AND SCOPOLINE. Schmidt, Hanns-Ludwig; Werner, Gottfried; Kumpe, Gerhard (Max-Planck-Institut fuer Hirnforschung, Frankfurt am Main). Ann. Chem., 688: 228-32(1965). (In German).

The labeling of (–)-scopolamine in the N-methyl group of the tropane ring was carried out by methylation of nor-(–)-scopolamine with $^{14}CH_3I$. The nor-(–)-scopolamine was prepared by the oxidation of (–)-scopolamine with $KMnO_4$ after protection of the alcoholic group of tropic acid by acetylation. After this step 11.8 mg $^{14}CH_3I$ (24 mC/mmol) was reacted with 0.166 mmol (a twofold excess) nor-(–)-scopolamine. The reaction mixture was treated with ethyl chloroformate in order to convert the unreacted nor-(–)-scopolamine to a neutral carbamate, easily separated from the tertiary base (–)-scopolamine, which was obtained in 78% yield. This yielded (–)-scopolamine-(N-$^{14}CH_3$)·HBr·H_2O on precipitation with ethereal HBr and recrystallization from aqueous alcohol. The methylation step also yielded small quantities of quaternary compounds whose hydrolysis product was identified as N-methylscopolinium ion by dilution analysis. From (±)-scopolamine (1.46 mC/mMol) were obtained scopine-(N-$^{14}CH_3$) by enzymatic hydrolysis and scopoline-(N-$^{14}CH_3$) by alkaline hydrolysis. The purity of all labeled compounds prepared was confirmed by paper chromatography, electrophoresis, and dilution analysis. (BBB)

23046 STUDIES OF ALCAPTONURIA: INFRA-RED SPECTRA OF DEUTERATED HOMOGENTISIC ACID SOLUTIONS. Milch, Robert Austin (Johns Hopkins Hospital, Baltimore). Arthritis Rheum., 8: 1002-5(Oct. 1965).

The autoxidized quinone-form polymers of homogentisic acid, but not the corresponding hydroquinone-form monomers, are capable of binding to and acting as interchain cross-linking agents for collagen structures. An investigation was undertaken to determine and compare the infrared spectra of monomeric and polymeric homogentisic acid solutions and to determine the effects of oxidizing agents on the probable structure of the homogentisic acid monomer. Twenty percent solutions of homogentisic acid were prepared in 99.5% deuterium oxide and in 1% D_2O solutions of $K_3Fe(CN)_6$. The data indicated that there is no similarity between homogentisic acid spectra and those reported for different melanins and that there is no detectable infrared spectral difference between colorless monomeric and pigmented polymeric homogentisic acid solutions. Furthermore, they suggest that both the monomeric and polymeric homogentisic acid compounds possess broad, heat-labile bands in the O–D stretching region and hence presumably occur mainly in a deuterium-bonded open lattice form. Carbonyl groups of the quinone nucleus were not deuterated to the corresponding aldol or gem-dihydroxy forms, as evidenced by the lack of broad vibrations in the 9–11 μ regions. Binding of homogentisic acid oxidation polymers to collagen structures and the failure of the unoxidized monomers to so bind can, therefore, be attributed primarily to steric factors. These in turn allow for the secondary occurrence of covalent bonding, presumably of the Schiff base type, between carbonyl groups on the one hand and the amino and/or amide groups of collagen network polymers on the other. (BBB)

23047 THE PREPARATION OF TRITIUM-LABELLED POLYETHYLENE GLYCOL AND ITS USE AS A SOLUBLE RUMEN MARKER. Till, A. R.; Downes, A. M. (CSIRO, Prospect, Australia). Brit. J. Nutr., 19: 435-42(1965).

In studies of ruminant digestion, to determine the fluid volumes and rates of passage of fluid through the gastrointestinal tract, polyethylene glycol (PEG) with a molecular weight of 3000 to 3700 can be used as a soluble reference material. To prepare the ^3H-labeled material unlabeled PEG 4000 (Carbowax, molecular weight 3200 to 3700) was ground, sieved (80 to 100 mesh), and dried under highly reduced pressure. Dry PEG 4000 was exposed for 28 days to ^3H gas in a glass ampoule fitted with a break-seal. A solution of ^3H-PEG 4000 was recovered and a portion purified by gel-filtration. The eluate was collected in 1.5-ml fractions, samples of which were assayed for ^3H by liquid scintillation counting. The ^3H-PEG was used as a soluble marker in two experiments on gastrointestinal function with one Merino-Border Leicester cross-bred wether provided with a rumen fistula. The disappearance of the marker from the rumen and its recovery in the excreta were measured both by liquid scintillation counting and by a chemical method. The two methods gave the same results within experimental error for the rumen volume estimate, rate of disappearance from the rumen, and for the recovery in the feces. A small amount of ^3H (2 to 3% of the dose) was recovered in the urine but the compound in which it was present was not chemically identified. It was concluded that PEG can be readily labeled with ^3H to give a substance which, except

for its radioactivity, is indistinguishable from unlabeled PEG in its behavior as a rumen marker. (BBB)

23048 METHANE-DEUTERIUM EXCHANGE OVER PLATINUM–RHODIUM ALLOYS. McKee, D. W.; Norton, F. J. (General Electric Research Lab., Schenectady, N. Y.). J. Catalysis, 4: 510-17(Aug. 1965).

The rate of exchange between methane and deuterium was studied on a series of unsupported platinum–rhodium alloys in the temperature range from 80 to 150°C. Stepwise exchange, leading to the successive formation of deuteromethanes, was the most important mechanism on all the alloy samples at the lower temperatures. The initial rates of formation of the species CHD_3 and CD_4 arising from multiple exchange increased with increasing temperature. Factors that may influence the mechanism of exchange on the platinum group metals are discussed. The highly deuterated products characteristic of multiple exchange may arise as a result of a rapid exchange of the hydrogens of the CH_2 radical by surface deuterium atoms, followed by deuteration of the metal-carbon double bond and subsequent desorption of the saturated species. The adsorbed methylene radical passes through a succession of isotopic changes on progressive deuteration. Ability to promote multiple exchange is probably related to the stability of complexes of the type $H_2C=Metal$. Assuming an inverse relation between the ability to promote multiple exchange and the strength of the C=Metal bond, it might be expected that the occurrence of multiple exchange would increase in the order $Pt \leq Pd < Rh < Ru \approx Ir$, and such a sequence was found for the CH_4-D_2 exchange reaction. (BBB)

23049 SYNTHESIS OF ^{3}H-ETHYL PARATHION. Hilton, B. D.; O'Brien, R. D. (Cornell Univ., Ithaca, N. Y.). J. Econ. Entomol., 58: 1025-6(Oct. 1965).

Methods using ^3H_2O for labeling some aromatic pesticides are considered. It was possible to achieve only a 2.5% isotopic yield in synthesizing parathion by reacting ^{3}H-ethanol with P_2S_5, chlorinating, and reacting with p-nitrophenate. The drawbacks to this procedure are that the ^{3}H-alcohol is introduced in the 1st step, and losses of ^{3}H inevitably occur in each of the later steps and that the ethylating step is usually driven by using a large excess of ethanol, and this is impossible when labeled ethanol is employed. An alternative procedure is described in which the ^{3}H-alcohol is introduced in the final step. The specific activity of the ^{3}H-ethanol used is extremely high, e.g., 740 mC/mmole. In principle, it should be possible to achieve similar specific activity in the product, but cost considerations usually necessitate use of small quantities of radioactivity (the 25-mC run described used ^{3}H-ethanol costing $105) and consequent extensive dilution. Work with these very small quantities led to substantial losses of radioactivity. The principle of ^{3}H alkylation in the terminal synthetic step should be applicable to other organophosphates. However, preparation of the appropriate dichloro compound is not always easy. It was possible to prepare the appropriate intermediate for ronnel and its P(O) analog, but not for malathion or dimethoate. (BBB)

23050 POLYTOPE LABELING OF DIGITOXIN WITH TRITIUM. Schmidt, H.-L.; Werner, G. (Max-Planck-Institut fuer Hirnforschung, Frankfurt am Main). J. Label. Compounds, 1: 300-3(Oct.-Dec. 1965). (In German).

A method for the preparation of tritium-labeled digitoxin free from transformations caused by the β radiation of the tritium is reported. Impure tritium-labeled digitoxin fractions were purified by adsorption chromatography on Al_2O_3. In order to obtain a higher yield rate of tritium in the digitoxin, the tritiation of digitoxin adsorbed on carbon powder was investigated. The digitoxin yield was higher and the effect of the tritium β radiation was lower in this process. (J.S.R.)

23051 POLYTOPE LABELLING OF D,L-GLUTAMINE WITH TRITIUM. Schmidt, H.-L.; Werner, G. (Max-Planck-Institut fuer Hirnforschung, Frankfurt am Main). J. Label. Compounds, 1: 304-5(Oct.-Dec. 1965). (In German).

The cation exchange-chromatographic purification of tritium-labeled D,L-glutamine is described. The mixture was first purified on the cation exchanger Dowex 50 with ammonium formate buffer. Subsequent purification steps used sodium citrate buffer in the same column followed by a chromatographic distribution on cellulose powder. Column chromatography on Dowex 50 with ammonium formate was the final step. Tritium-labeled D,L-glutamine was obtained with no impurities. (J.S.R.)

23052 SYNTHESIS OF 2,6-DIOXO-3-PHTHALIMIDOPIPERIDINE-3,4,4,5,5-d_5 AND 2,5-DIOXO-3-PHTHALIMIDOPYRROLIDINE-3,4,4-d_3 FROM L-DEUTERIO-GLUTAMIC ACID AND L-DEUTERIO-ASPARTIC ACID. Rhodes, Harold J.; Fang, Sen Maw; Blake, Martin I. (Univ. of Illinois, Chicago). J. Pharm. Sci., 54: 1440-3(Oct. 1965).

The availability of metabolites containing D atoms in nonexchangeable positions makes possible the preparation of a wide variety of pharmacologically active derivatives in which a substantial number of H atoms are replaced by D atoms. The isolation and characterization of L-deuterio-glutamic acid and L-deuterio-aspartic acid from the ionic fraction of the hydrolysate of the algae Scenedesmus obliquus are described. These deuterated amino acids were employed for the synthesis of 2,6-dioxo-3-phthalimidopiperidine-3,4,4,5,5-d_5 and 2,5-dioxo-3-phthalimidopyrrolidine-3,4,4-d_3, which are analogs of thalidomide. The following sequence of reactions was utilized: phthaloylation with N-carbethoxyphthalimide, heating with acetic anhydride, and heating with urea. Compounds containing a significant number of D–C bonds should be useful for various studies. Since both 2,6-dioxo-3-phthalimidopiperidine and 2,5-dioxo-3-phthalimidopyrrolidine elicit sedative and teratogenic activity, the effect of D substitution on these activities can be evaluated. Such studies may provide information concerning the mechanism by which these agents produce their effects. The rupturing of a C–D bond is considerably more difficult than a C–H bond. Accordingly, if oxidation of C–D bonds is involved in the metabolism of these drugs, a pronounced effect on the pharmacological activity should be observed. Such studies are currently being undertaken. (BBB)

23053 RADIOSYNTHESIS OF DEXTROAMPHETAMINE-^{14}C SULFATE. Blackburn, Dale; Burghard, Garth (Smith Kline and French Labs., Philadelphia). J. Pharm. Sci., 54: 1586-8(Nov. 1965).

Relatively large quantities (80 to 90 mC) of ^{14}C-tagged d-amphetamine sulfate are required for metabolic and pharmaceutical studies. A high-yield radiosynthesis of dl-amphetamine-7-^{14}C was developed using 0.5 C of benzoic-7-^{14}C acid as the starting material. Yields of 84% were obtained by the successive crystallization. Of the various microchemical syntheses available for the preparation of benzaldehyde-7-^{14}C, the reduction of benzoyl-7-^{14}C chloride with lithium aluminum tritertiarybutoxy hydride appeared to be the simplest method for the 100-mmolar scale contemplated. The low-temperature reduction of acid chlorides in diglyme gave 55 to 60% of a crude benzaldehyde. Significant amounts of benzaldehyde were lost in the extractive purification due to its solubility in aqueous diglyme. The use of tetrahydrofuran as the reaction medium gave consistent 75% yields of benzaldehyde. Various condensation reactions between benzaldehyde and nitroethane were explored. The best yields were obtained by refluxing the aldehyde with excess nitroethane in benzene and removing the water formed. The resulting crude 1-phenyl-2-nitropropane was then converted to dl-amphetamine in 80 to 85% yields by reduction with lithium aluminum hydride. The dl-amphetamine was purified by an acid-base extraction to remove neutral side-products formed in the reaction sequence. Cyclic crystallization of d-amphetamine-^{14}C d-bitartrate and l-amphetamine-^{14}C l-bitartrate from the enriched d-isomer and l-isomer mother liquors, respectively, was used for quantitative resolution of the dl-amphetamine-^{14}C. This method was used since a 97% optical purity could be realized with a single crystallization with rigid temperature control. It

was thus possible to obtain an 85 to 90% recovery of the optical isomers. (BBB)

23054 REACTIONS OF TRITIUM ATOMS WITH TRITIUM-LABELED ISOPROPYL RADICALS AT 63 DEG K. Watkins, K. W.; Moser, H. C. (Kansas State Univ., Manhattan). J. Phys. Chem., 70: 1137-40(Apr. 1966).

DT, tritiated propene, and tritiated propane were obtained as products of reactions of tritium atoms with a solid mixture of propene-d_6 and isopentane (mole ratio 1:1000) at 63°K. These products are interpreted as having resulted from disproportionation and combination reactions of T atoms with i-C_3D_6T radicals. Disproportionation to combination ratios, k_d/k_c, for tritium atom reactions with i-C_3H_6T and i-C_3D_6T radicals at 63°K were determined to be 3.55 ± 0.05 and 3.05 ± 0.10, respectively. These ratios were used to calculate a value of 1.2 for the hydrogen–deuterium kinetic isotope effect, k_H/k_D, in the disproportionation reaction. The similarities of H atom–alkyl radical and alkyl–alkyl radical disproportionation and combination reactions are discussed. (auth)

23055 STUDIES ON POLYOXYMETHYLENE. I. SMALL-ANGLE X-RAY STUDIES ON POLYOXYMETHYLENE FIBERS. Suzuki, Yasuo; Sakurada, Ichiro. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 23-38(1964-1965). (In Japanese).

Delrin and Celcon fibers were prepared by a melt spinning technique from the corresponding commercial resins. The effects of heating and drawing on the small-angle x-ray scattering patterns of the fibers were studied. Discrete diffraction patterns showed the presence of a long period. By heat treatment at 100 and 150°C in silicon oil at a constant length, the intensity of the discrete diffraction on the meridian and the long period were increased, while the intensity of diffuse scattering on the equator was decreased. As the fibers were drawn, the intensity of diffraction patterns on the meridian of these fibers decreased and the maximum of the discrete diffraction became indistinct and finally disappeared. (auth)

23056 ESR STUDY ON THE SOLID STATE POLYMERIZATION OF N-VINYL CARBAZOLE INITIATED BY ELECTRON ACCEPTORS. Tsuji, Kozo; Takakura, Koichi; Nishii, Masanobu; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 179-80 (1964-1965).

Solid-state polymerization of N-vinyl carbazole (N-VCZ) in the presence of chlorine and sulfur dioxide was studied to determine if polymerization is initiated by cation radicals derived from charge-transfer complexes between N-VCZ and the electron acceptor. ESR spectra obtained for almost all the complexes were singlet spectra and no hyperfine splitting could be resolved for the solid. The mechanism of polymerization of N-vinyl carbazole by electron acceptors is shown. (F.J.H.)

23057 POLYMERIZATION OF TRIOXANE AND TETRAOXANE IN THE PRESENCE OF GASEOUS ELECTRON ACCEPTOR. Nishii, Masanobu; Tsuji, Kozo; Takakura, Koichi; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 181-8(1964-1965). (In Japanese).

Solid-state polymerization of trioxane, tetraoxane, and N-vinyl carbazole by gaseous electron acceptors such as chlorine (Cl_2) and sulfur dioxide (SO_2) was examined. Solid-state polymerization of trioxane induced by Cl_2 gas proceeded well at temperatures higher than 25°C and polymer yield was reduced in solution. The melting point of the polymer obtained was 178°C, however the molecular weight was very small because of the degradation of the polymer formed during polymerization. Trioxane was also polymerized by SO_2 even in the liquid state at higher temperature. Eutectic mixtures of trioxane and N-vinyl carbazole (VCZ) were treated by Cl_2 or SO_2 gas to produce a copolymer. From fractionation studies the existence of a block copolymer of polyoxymethylene and poly-vinyl carbazole was recognized. Tetraoxane was also polymerized by Cl_2 and SO_2 gas in the solid state. The initiation mechanism was clarified by means of ESR measurements. A singlet spectrum and an antisymmetric doublet spectrum were observed, when VCZ was treated with Cl_2 and SO_2, respectively. These spectra may be attributed to a cation radical of VCZ, which is derived from a charge transfer complex between VCZ and the electron acceptors. Similar spectra were also observed in the case of iodine and bromine. The spectrum was not changed during the polymerization and the monomer was polymerized easily by a cationic mechanism. Therefore, an initiating species may be considered to be a cation radical in which an odd electron is delocalized over the conjugated double bond system of carbazole ring. (auth)

23058 POLYMERIZATION OF N-VINYLCARBAZOLE BY MALEIC ANHYDRIDE AS AN ELECTRON ACCEPTOR. Takakura, Koichi; Kawa, Eiko; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 205-13(1964-1965). (In Japanese).

Polymerization of N-Vinylcarbazole (VCZ) occurred by the addition of an excess of maleic anhydride (MAH) both in bulk and in solutions. When the mixture of VCZ and a large amount of MAH was allowed to stand at 70°C or in toluene solution at 50°C, high yields of polymer were obtained within 1 hr. The resulting polymer was confirmed to be a homopolymer of VCZ. At the same time the polymerizing system developed an intense yellow color, which was attributed to the formation of the charge transfer complex between VCZ and MAH. The polymerization took place in the presence of air, and of a radical scavenger such as DPPH. It was found that polymerization was markedly enhanced in a polar solvent such as acetone, and moreover MAH acted not only as an initiator, but also as a favorable solvent for the polymerization. An ESR spectrum of the mixture of VCZ and MAH showed a singlet, which may be due to a cation radical of VCZ arising from the complex. It is suggested that a cation radical with localized carbonium ion formation may initiate the polymerization by a cationic mechanism, in which an anion radical of MAH would act as a counter ion for a propagating chain end. (auth)

23059 IONIZATION AND DISSOCIATION OF ALIPHATIC KETONES. Hatada, Motoyoshi; Hirota, Kozo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 219-42(1964-1965). (In Japanese).

Ionization potentials and positive charge distributions of group bonds of ten aliphatic ketones were calculated by an extended group-bond orbital method. The calculated ionization potentials of these ketones agreed well with the observed values. The calculated positive charge distributions showed good correlations to the bond-scission probabilities obtained from mass spectra. (auth)

23060 IONIZATION AND DISSOCIATION OF ALIPHATIC ETHERS UNDER ELECTRON IMPACT. Takezaki, Jun'chi; Hirota, Kozo; Hatada, Motoyoshi. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 243-6(1964-1965). (In Japanese).

The method of group bond orbital on mass spectrum was applied to calculate the ionization potentials and bond-scission probabilities of aliphatic ethers. The calculated ionization potentials agreed well with the measured ones. The calculated positive charge distributions showed fair correspondences to the bond-scission probabilities obtained from their mass spectra except in the case of methyl-n-propyl ether. (auth)

23061 SYNTHESIS OF 3-HEPTANONE-2,2,4,4-d_4. Hatada, Motoyoshi; Okada, Mitsuo; Hirota, Kozo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 279-82(1964-1965). (In Japanese).

3-Heptanone-2,2,4,4-d_4 was synthesized by repeated exchange of 3-heptanone with deuterium oxide. It was found by mass, NMR, and infrared spectrometry that almost all of the four hydrogen atoms attached to the α-carbons were exchanged by deuterium. (auth)

23062 SPECTROSCOPIC EVIDENCE OF LIGAND INTERACTIONS WITH 5f-ORBITALS. Jezowska-Trzebiatowska, B.; Bartecki, A.; Bukietynska, K.; Kakolowicz, W.; Kedzia, B. (Univ., Wroclaw. Tech. Univ., Wroclaw). pp 95-105 of Proceedings of the Symposium

on Coordination Chemistry. Beck, Mihaly T. (ed.). Budapest, Akademiai Kiado, 1965.

On the basis of extensive spectroscopic investigations, peculiarities of 5*f*-orbitals and their participation in the bond formation of uranium(IV) and (VI) are discussed. A magnitude ζ_{3p} as a measure of ligand field interaction was accepted and on this basis the spectrochemical series of ligands for uranium(IV) was set up. Ligand influence on the structure of the uranyl entity is demonstrated. Spectrochemical series were proposed for uranyl on the basis of ν_1', ν_3'', and ν_1'. (auth)

23063 OUR EXPERIENCE WITH THE PREPARATION OF LABELED o-IODOHIPPURIC ACID. Eysselt, Milos (Medical Faculty, Univ., Brno). Scripta Med. Fac. Med. Univ. Brun. Palackyanae, 36: 313-22(1963). (In Czech).

Improvements in the synthesis of ^{131}I-labeled o-iodohippuric acid from anthranilic acid are described. Anthranilic acid was diazotized and treated with KI to yield o-iodobenzoic acid, whose purity was markedly improved by treatment of an alcoholic solution with charcoal, evaporation of the alcohol, and recrystallization from water. The acid was converted to the acid chloride in an excess of thionyl chloride, which was removed from the reaction mixture by distillation. The o-iodobenzoyl chloride was reacted with glycine under modified Schotten-Baumann conditions. The o-iodohippuric acid was purified by recrystallization and treated at the 20-mg level in a 2-ml ampoule with 2 to 5 mC $^{131}I_2$ for 3 hr at 114°C, and was then treated with a series of NaOH, NaI, and HCl solutions to free the acid from side products, and sterile physiological solutions were prepared at pH 7 from the final product. The exchange reaction was similar to that of Sheer and Meier-Borts (Nucl. Med., 2: 193-7(1961)). (BBB)

23064 THE CATALYTIC REDUCTION OF 3β-HYDROXYANDROST-5-EN-17-ONE WITH TRITIUM. THE DISTRIBUTION AND ORIENTATION OF LABEL IN THE PRODUCT. Brodie, H. J.; Bab, S.; Gut, M.; Hayano, M. (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). Steroids, 6: 659-74(Dec. 1965).

To investigate the participation of hydrogen at C-6 in some enzymatic and chemical reactions of a Δ^4-3-ketosteroid, a compound with a label at C-6α was prepared. Catalytic reduction of dehydroepiandrosterone (I) (3β-hydroxyandrost-5-en-17-one) with tritium gas was carried out in the expectation of obtaining 3β-hydroxy-5α-androstan-17-one-5α, 6α-^{3}H (II), which was converted to 6α-^{3}H-androstenedione (III) (androst-4-ene-3, 17-dione-6α-^{3}H). Proof is provided for the distribution of tritium in the saturated product from this reduction and some chemical reactions, which may be used to indicate the distribution of a label at carbons six and seven, are reported. Chromatography showed about 90% of the radioactivity in II. A small peak containing about 10% of the radioactivity occurred in the area corresponding to 3β-hydroxy-5β-androstan-17-one. The radioactive area corresponding to II was diluted with carrier II, oxidized with chromic acid in acetone to 5α-androstanedione (IV) (5α-androstane-3,17-dione), and equilibrated with base. There was an insignificant (3%) loss of tritium in the oxidation and equilibration steps showing that little tritium was incorporated in positions 2, 3α, 4, and 16 in the reduction. Bromination of IV gave 2,4-dibromo-5α-androstanedione (V) without loss of tritium. The dibromide was treated with sodium iodide in acetone and the resultant mixture, when chromatographed on a silica gel column, gave 2-iodoandrostenedione (VI) and III, both of the same specific activity (57% of IV). When VI was converted to the corresponding androstenedione with zinc and acetic acid there was a 10% loss of tritium. Equilibration of III with base resulted in an initial rapid loss of activity followed by a much slower decrease. The expected kinetics for a first-order reaction was obtained for the slower exchange after the tritium was eliminated from the more easily affected position. This indicated that in the reduction of the Δ^5-bond, all the tritium was not at carbons five and six. Other results showed that the additional tritium was at C-7α. Distribution of tritium in II was 43% at 5α, 35% at 6α, and 22% at 7α. (BBB)

23065 RATES OF SOLVOLYSIS OF DIETHYL DICARBONATE AND ETHYL CHLOROFORMATE IN LIGHT AND HEAVY WATER AT 25 DEG C. Kivinen, Antti (Univ. of Helsinki). Suomen Kem., 38B: 205-6(1965).

To obtain further evidence for the validity of a mechanism proposed for the hydrolysis of diethyl dicarbonate, the rate of solvolysis of this ester in heavy water was measured. For comparison, the rate of hydrolysis of the corresponding acid chloride, ethyl chloroformate, also was measured in D_2O. The rate constant of the solvolysis of diethyl dicarbonate in D_2O was found to be 16.7×10^{-5} sec^{-1} and that of the solvolysis of ethyl chloroformate 20.0×10^{-5} sec^{-1} at 25°C. The respective rates in H_2O are 41.8×10^{-5} sec^{-1} and 38.9×10^{-5} sec^{-1}. Thus the ratio k_{H_2O}/k_{D_2O} is 2.50 for the solvolysis of diethyl dicarbonate and 1.95 for the solvolysis of ethyl chloroformate. Values for the kinetic solvent isotope effect k_{H_2O}/k_{D_2O} in solvolytic reactions of various acid anhydrides in water are of the same magnitude as the value 2.5 found for diethyl dicarbonate. The values of k_{H_2O}/k_{D_2O} for the spontaneous solvolysis of carboxylic esters often are also of the same order as the values for the solvolysis of acid anhydrides. Therefore, the value of 2.50 found for the solvolysis of diethyl dicarbonate does not afford any additional evidence that would decide the question whether the reaction takes place by acyl-oxygen or anhydride bond fission. The value does, however, lend support to the mechanism proposed for the hydrolysis of diethyl dicarbonate. (BBB)

23066 THE UNRELIABILITY OF ASSOCIATION CONSTANTS OF ORGANIC CHARGE-TRANSFER COMPLEXES DERIVED FROM OPTICAL ABSORPTION SPECTRA. II. APPARENT ISOTOPE EFFECTS SHOWN BY THE TETRACYANOETHYLENE COMPLEXES OF BENZINE AND BENZENE-d_6. Emslie, P. H.; Foster, R. (Univ. of St. Andrews, Dundee, Scotland). Tetrahedron, 21: 2851-5(Oct. 1965).

A comparison was made of the optical and thermodynamic properties of the charge-transfer complex benzene-tetracyanoethylene in cyclohexane with those of the corresponding benzene-d_6 complex using an optical method. The relatively low energies of the intermolecular transitions of tetracyanoethylene complexes enabled the apparent association constants, K_{exp}, to be determined from direct measurements on the optical charge-transfer band. From the variation of K_{exp} with temperature within the range from 6.3 to 33°C the apparent enthalpy (ΔH) and apparent entropy (ΔS) changes were calculated for an assumed equilibrium: $A + D \rightleftharpoons AD$, where A is the electron acceptor, tetracyanoethylene, and D is the electron donor, benzene or benzene-d_6. From the values of K_{exp}, the apparent molar extinction coefficients (ϵ_{exp}) and the apparent shapes of the intermolecular charge-transfer absorption bands were obtained for the two complexes. Differences were noted in the calculated intensity of the intermolecular charge-transfer band, but not in its position. Although the differences in the measured values of the association constant at various temperatures are apparently accounted for by differences in the entropy change of complex formation, it is suggested that a failure of Beer's law gives a better account of all these differences. Deviations from Beer's law for tetracyanoethylene-benzene in solutions of cyclohexane containing varying amounts of benzene were different from the deviations for tetracyanoethylene-benzene-d_6. It is shown that deviations of ~5% from Beer's law in absorptions of the complex species (AD) in 0.2 M solutions of donor can easily give rise to differences in K_{exp} of ~20%. (BBB)

23067 A SOLVENT ISOTOPE EFFECT UPON THE ACETOLYSIS OF AN EPOXIDE. Isaacs, Neil S. (Univ. of Victoria, Can.). Tetrahedron, No. 50, 4549-51(Dec. 1965).

During the acid-catalyzed acetolysis of propylene oxide in glacial acetic acid, ring-opening occurred yielding principally propylene glycol β-monoacetate (abnormal

ring fission), presumably by way of the more stable carbonium ion. This system was investigated to test the prediction that a solvent isotope effect should be observed in acetic acid-d and that its magnitude, measured by the value of k_H/k_D should be ~1.1. The rates of acetolysis of propylene oxide in pure acetic acid and acetic acid-d were measured employing a gas-chromatographic analytical technique. Reproducible pseudo first-order kinetics were observed and specific rate constants evaluated. The results supported the prediction although the magnitude of the effect was unexpectedly high. One of several considerations is proposed to account for this discrepancy. The predicted value of k_H/k_D was made on the basis of the protonation of tertiary amines in acetic acid and acetic acid-d and may not be strictly applicable to oxygen bases. The absolute values for the dissociations of these amines may be slightly in error due to uncertainty in the values of the extinction coefficients for the free bases. A third possibility is that ring-opening is brought about by attacks of acetate ions rather than molecules of acetic, either directly or by applying its influence as a base through solvent molecules. The concentration of acetate ions must be higher in acetic acid than in acetic acid-d thus bringing about an amplification of the isotope effect. The carbonium ion produced may then be incipient rather than free. (BBB)

23068 THERMAL DECOMPOSITION OF TRITIATED 2,4,6-TRIPHENYL-5-t-1,3,2-DIOXABORINIUM PERCHLORATE. Barabas, A.; Mantescu, Constanta; Duta, Doina; Balaban, A. T. (Inst. of Atomic Physics, Bucharest). Tetrahedron Lett., No. 44, 3925-8(Nov. 1965).

The decomposition of 2-phenyl-1,3,2-dioxaborinium perchlorates (I) takes place at ca 100°C in solid state or in an inert solvent. A plausible mechanism for its decomposition in the absence of hydrogen donors involves the homolytic breaking of the carbon–boron bond. The resulting phenyl radical then abstracts a hydrogen atom from the ligand molecule (either from the phenyl rings, or from the central atom) of the 1,3-diketone. A study of the thermal decomposition of isotopically labeled I was made. Dibenzoylmethane (II) was tritiated at the methylene group by refluxing for one hour in ethanol with tritiated water, followed by recrystallization. This product was then converted to I by stirring at 0°C for 4 hr the reagents of the reaction in dry dichloromethane; after filtration, washing with dichloromethane and drying in vacuum at room temperature, I or 2,4,6-tri-phenyl-5-t-1,3,2-dioxaborinium perchlorate was obtained in 82% yield. Thermal decomposition was performed by heating for 40 min at 100°C in an evacuated vial (8 mm pressure) and condensing the volatile products in a trap cooled at −50°C. Preparative gas chromatography of these products after drying over sodium from water formed in the decomposition showed that they consist of 95% benzene (yield 90%) and 5% of a more volatile product, whose separation did not modify the activity of the volatile fraction. The residue was recrystallized from dry acetonitrile (yield 27%). (BBB)

23069 CHROMATOGRAPHIC PURIFICATION OF HIGHER ^{14}C-LABELED FATTY ACIDS. Heise, K.-H.; Knappe, Thea (Zentralinstitut fuer Kernforschung, Berlin). Z. Chem., 5: 301-2(1965). (In German).

An improved synthesis for labeled fatty acids is described. Impurities in ^{14}C-carbonyl fatty acids prepared by carboxylation of Grignard reagents with $^{14}CO_2$ are generally the corresponding alkane and ketone, the former arising from hydrolysis of unreacted Grignard reagent and the latter by reaction of Grignard reagent with the Mg carboxylate. Addition to the method of preparation of a chromatographic separation of acid from side-products is described. The ketone is eluted with 180 ml CCl_4–C_6H_6 (80:20, vol), and the carboxylic acid is eluted with 150 ml diisopropyl ether. Purity of each fraction is demonstrated by thin-layer chromatography on Kieselgel G with benzene as solvent, and I_2 as developer. (BBB)

23070 PREPARATIVE ISOLATION AND TRITIUM LABELING OF 3-HYDROXY-L-KYNURENINE. Ishiguro, Isao; Linzen, Bernt (Max-Planck-Institut fuer Biochemie, Munich). Z. Physiol. Chem., 340: 286-8(1965). (In German).

A technique for the isolation of 3-hydroxy-L-kynurenin from Calliphora pupae by acid extraction and ion exchange chromatography and the incorporation of ^{3}H into it is reported. Acid-catalyzed ^{1}H-^{3}H exchange was employed in the labeling. A solution of 200 mg 3-hydroxy-L-kynurenin in 1 ml 1 N HCl was prepared using acid containing about 1 C ^{3}H. After evacuation the solution was heated to 90°C for 2 hr. The solvent was removed by distillation and drying over KOH and labile ^{3}H was removed by washing with methanol until removed activity was less than 1.5% of bound activity. For purification the material was dissolved in a little water and chromatographed over a long Sephadex column. Three substances were obtained, of which the first had the same fluorescence as 3-hydroxykynurenin and was obtained in reasonable yield as crystals: 107 mg, specific activity 8.1 mC/mmol. Experiments were performed to study detritiation in acid solution: one sample lost 20% of its activity in HCOOH on standing 24 hr; another lost 40% of its activity in 2% methanolic HCl in 24 hr. In the latter case new fluorescent bands were observed on the chromatogram. (BBB)

Radiation Chemistry

See also BIOLOGY AND MEDICINE — Radiation Effects on Biochemicals Radiation Effects on Tissues

Refer also to abstracts 23025, 23606, and 24459.

23071 (AGN–8169) FISSIOCHEMICAL DEVELOPMENT PROGRAM. Monthly Progress Report, October 1965. (Aerojet-General Nucleonics, San Ramon, Calif.), Nov. 1965. Contract AT(04-3)-596. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Developments in studies on: energy deposition from 20 wt % U–Pd alloy fission fragment-fuel interaction; fission fragment irradiations of nitrogen-methane mixtures; nitrogen atom yields in radiolysis of nitrogen systems; preparation and stability of fibrous fissiochemical fuels; fissiochemical synthesis; and process design and economics are reported. (P.C.H.)

23072 (BAW–269) RADIOCHEMISTRY OF NUCLEAR FUELS. Quarterly Progress Report No. 1, August 1–October 31, 1964. Mueller, J. J.; Dewell, E. H. (Babcock and Wilcox Co., Lynchburg, Va.). 14p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The preparation of nuclear fuel test samples for low power exposure and their encapsulation for in-pile work are reported. The fuel samples consisted of UO_2 and mixed ThO_2–UO_2. The irradiation assembly and capsule makeup are described. (P.C.H.)

23073 (CEA-R–2873) CONTRIBUTION A L'ETUDE DE L'EFFET SZILARD-CHALMERS DANS LE FERROCYANURE DE POTASSIUM [These]. (Contribution to the Study of the Szilard-Chalmers Effect in Potassium Ferrocyanide [Thesis]). Meriadec, Brigitte (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 1966. 32p. Dep. mn.

During studies on the Szilard-Chalmers effect in potassium ferrocyanide, a chemical separation method was developed for the different ions formed by recoil: Fe^{2+}, Fe^{3+}, and the complex forms of iron. A measurement method was developed also for analyzing separately the isotopes ^{55}Fe and ^{59}Fe and determining the relative amounts of these two isotopes in different chemical states. The experimental results show that the activity of the two isotopes is distributed differently between the complex forms of iron, the ferrous ions, and the ferric ions. This difference is of the order of 40% in the ferrous solution and of 2 to 5% in the ferric retention and ferric solution. (auth)

23074 (INR–673/XVII/C) EFEKTY CHEMICZNE MILISEKUNDOWYCH WYLADOWAN ELEKTRYCZNYCH W DOZYMETRZE FRICKE'GO. (Chemical Effects of

Electric Discharges of Millisecond Duration in Fricke Dosimeters). Zagorski, Zbigniew P.; Grodkowski, Jan (Institute of Nuclear Research, Warsaw (Poland)). Dec. 1965. 18p. Dep.

Electric discharges of millisecond duration submerged in liquid phase were used as the energy source to generate intermediate species similar to those generated by irradiation in Fricke dosimeters. The energy was determined calorimetrically. The iron(III) yield was found to be G = 0.3 – 0.5. Several analogies were found between the effects of electric discharge and radiation on the Fricke dosimeter. (P.C.H.)

23075 (NYO–2807-12) ATOMIC EXCHANGE REACTIONS IN NITROGEN GAS. Axtmann, Robert C. (Israel Atomic Energy Commission, Yavne. Soreq Research Establishment). [1964]. Contract AT(30-1)-2807. 13p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

An analysis of γ- and x-radiolytic experiments on mixtures of $^{14}N_2$ and $^{15}N_2$ indicates that a hot atom chain reaction, initiated by atoms from electronic recombination of nitrogen ions, is responsible for the molecular exchange. The analysis establishes an upper limit of $k_c \leq 1.8 \times 10^{-19}$ cm^3/atom-sec at room temperature for the bimolecular rate constant in the thermal atomic chain reaction $N' + N - N \xrightarrow{k_c} N + N' - N$. (auth)

23076 (UCRL–16580, pp 207-12) RADIATION CHEMISTRY. (Lawrence Radiation Lab., Univ. of California, Berkeley).

Investigations of hydrated electron reactivity with organo-nitrogen compounds are reported. Research on the formation of unsaturated products in radiolysis of solid-state peptides is summarized. (J.R.D.)

23077 (AEC-tr–6466/1, pp 32-8) PROSPECTS FOR THE INDUSTRIAL APPLICATIONS OF RADIOCHEMISTRY IN THE U.S.S.R. Karpov, V. L. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A brief survey of research on radiochemical processes is presented. (D.C.W.)

23078 (AEC-tr–6466/1, pp 158-64) GAMMA SOURCES FOR RADIOCHEMICAL DEVICES. Breger, A. Kh. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Possible applications of radiation sources in radiochemical installations are discussed. Gamma-radiation power is studied as a function of loading time, plant production capacity, and average power. General guidelines for research and for the construction of radiochemical installations are also given. (G.O.Y.)

23079 (AEC-tr–6466/1, pp 165-72) BASIC TECHNOLOGICAL CHARACTERISTICS OF A FEASIBLE INDUSTRIAL-SCALE ETHYLENE-POLYMERIZATION RADIATION INSTALLATION. Syrkus, N. P.; Breger, A. Kh.; Vainshtein, B. I. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A study of the basic technological parameters of a radiochemical installation for the polymerization of ethylene is summarized. (D.C.W.)

23080 (AEC-tr–6466/1, pp 173-86) INTENSIFICATION OF RADIATION VULCANIZATION, AND THE TECHNICAL PRINCIPLES OF AN EXPERIMENTAL INSTALLATION FOR THE RADIATION VULCANIZATION OF TIRES. Dogadkin, B. A.; Tarasova, Z. N.; Kaplunov, M. Ya.; Breger, A. Kh.; Kepersha, L. M.; Vainshtein, B. I.; Vizel', Ya. M.; Karpov, V. L. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The factors influencing the degree of structurization of rubber in radiation vulcanization were investigated. Some catalysts of the class of polyhalide aliphatic compounds, which secure the production of static strength equal to that of sulfur vulcanizates and reduce the radiation dose required by 50%, were discovered. It was established that the combined vulcanization of carboxyl-containing rubbers by metallic oxides and by the action of ionizing radiation (approximately 10 MR) yields rubbers with high heat resistance and good strength parameters. The kinetics of combining several monomers in the radiation vulcanization of natural and butadiene–styrol rubber were also investigated. A technological process scheme was proposed for the experimental radioinduced vulcanization of tires using spent reactor fuel elements. (G.O.Y.)

23081 (AEC-tr–6466/1, pp 187-90) CHLORINATION OF SILICON-CONTAINING MONOMERS AND POLYMERS UNDER THE INFLUENCE OF GAMMA RADIATION. Dzhagatspanyan, R. V.; Zetkin, V. I.; Motsarev, G. V.; Filippov, M. T. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Solutions of polydimethylsiloxane rubber $[(CH_3)_2SiO]_n$ and of polyphenylmethylsiloxane $[(C_6H_5)(CH_3)SiO]_n$ polymers in CCl_4 in the pure state or in solution were chlorinated at 0°C in evacuated glass capsules or in a glass vessel in which the chlorine was continuously fed into the solution. The gamma radiation used was from a ^{60}Co source with an activity of 1400 g-equiv of radium. The chlorination of monomers was also investigated. (G.O.Y.)

23082 (AEC-tr–6466/1, pp 191-6) RADIOCHEMICAL SULFOCHLORINATION AND SULFOOXIDATION OF POLYETHYLENE, POLYPROPYLENE, POLYISOBUTYLENE, AND PARAFFIN HYDROCARBONS. Dzhagatspanyan, R. V.; Zetkin, V. I.; Zykova, E. N.; Filippov, M. T. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The sulfochlorination and sulfo-oxidation of polyethylene, polypropylene, polyisobutylene, and paraffin hydrocarbons, and the chlorination of silicon-organic compounds was investigated using a ^{60}Co source with an activity of 1400 g-equiv of radium. The paraffin hydrocarbons were sulfochlorinated and sulfo-oxidated in the pure state at room temperature or slightly below (0° to 25°C). The polymers were only sulfochlorinated in a CCl_4 solution or in 2 solution of polypropylene. (G.O.Y.)

23083 (AEC-tr–6466/1, pp 197-202) RADIOTHERMAL CRACKING OF HYDROCARBONS. Topchiev, A. V.; Polak, L. S.; Chernyak, N. Ya.; Glushnev, V. E.; Glazunov, P. Ya.; Vereshchinskii, I. V.; Syrkus, N. P.; Breger, A. Kh.; Vainshtein, B. I. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Some 0.25 ml samples of liquid n-heptane were irradiated by a ^{60}Co source that delivered a total dose of 2×10^{19} Mev/sec/ml. It was shown that the production of hydrogen, methane, and unsaturated compounds deviates from the linear relationship only at high total doses. Other preliminary experiments on the radiothermal cracking of naphthene hydrocarbons and crude oils gave promising results. Several possible radiation sources for radiothermal cracking processes were also considered. (G.O.Y.)

23084 (AEC-tr–6466/1, pp 203-10) RADIOCHEMICAL TELOMERIZATION. Beer, A. A.; Besprozvannyi, M. A.; Limanova, T. I.; Filippov, M. T. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The radioinduced telomerization between ethylene and carbon tetrachloride and between tetrafluoroethylene and methyl alcohol was investigated using a ^{60}Co gamma source. On the basis of the results, a design was proposed for an installation for the continuous radiochemical telomerization of ethylene and carbon tetrachloride. (D.C.W.)

23085 (AEC-tr–6466/1, pp 211-18) THE USE OF NUCLEAR RADIATION ENERGY IN THE POLYMERIZATION OF FLUORO-OLEFINS. Zimakov, P. V.; Volkova, E. V.; Fokin, A. V.; Sorokin, A. D.; Belikov, V. M. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The results are presented of an investigation of the ra-

dioinduced polymerization of trifluorochloroethylene in Cl-containing solvents and in the pure monomer, of the radio-induced polymerization of tetrafluoroethylene in various media, and of the radioinduced copolymerization of various fluoroolefins. The source used was a ^{60}Co source with an activity of 5000 g-equiv of radium. (G.O.Y.)

23086 (AEC-tr-6466/1, pp 219-25) THE K-60,000 GENERAL-PURPOSE RADIOCHEMISTRY TEST AND MODELING INSTALLATION CONTAINING A ^{60}Co RADIATION SOURCE WITH AN ACTIVITY OF 60,000 g-equiv. OF RADIUM. Breger, A. Kh.; Osipov, V. B.; Gol'din, V. A. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The design, operation, and testing of an installation that was developed for the investigation of radiochemical methods and processes are discussed. (D.C.W.)

23087 (AEC-tr-6466/1, pp 238-41) CROSS-LINKING OF TEFLON AND OTHER POLYMERS BY THE LOCALIZED ACTION OF NEUTRON RADIATION. Barkalov, I. M.; Gol'danskii, V. I.; Dzantiev, B. G.; Egorov, E. V. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Localized radioinduced cross-linking of polystyrene and teflon, polymethylmetacrylate and polystyrene, and polymethylmetacrylate and teflon was effected by immersing the materials in solutions of boron- or lithium-containing compounds prior to irradiation with thermal neutrons. Neutron reactions with the boron or lithium in the surface layer limited the action of the radiation to the vicinity of the surface. (D.C.W.)

23088 (AEC-tr-6466/1, pp 242-4) THE USE OF NUCLEAR RADIATION IN THE CHLORINATION OF BENZENE TO YIELD HEXACHLORANE. Krasnousov, L. A.; Zimakov, P. V.; Volkova, E. V.; Belikov, V. M. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The results of an investigation of the radioinduced chlorination of benzene to yield hexachlorocyclohexane are summarized, and a fully automated system for the production of hexachlorocyclohexane is proposed. (D.C.W.)

23089 INVESTIGATIONS IN THE FIELD OF RADIATION-INDUCED SOLID STATE POLYMERIZATION. [PART] XIV. THE γ-RADIATION-INITIATED POLYMERIZATION OF ALLYL PALMITATE. Hardy, Gy.; Nagy, L.; Cser, F. (Research Inst. for the Plastics Industry, Budapest). Acta Chim. Acad. Sci. Hung., 47: 211-19(1966).

The kinetic character of the radiation polymerization of allyl palmitate is linear in both the solid and the liquid states. The rates of polymerization in the solid state, represented as functions of the temperature, showed a maximum near the melting point. Degradative chain transfer, which is characteristic of allylic compounds, played a part in both the liquid and solid-state polymerizations. Polymerization proceeded in both phases according to a radical mechanism. The system p-benzoquinone-allyl palmitate had an extreme eutectic when it contained 7.6 mole % of p-benzoquinone. On the basis of the results of x-ray diffraction studies, an interpretation is presented to account for the particular activity of radical inhibitors in the solid-state polymerization of monomers containing long-chain aliphatic substituents. (auth)

23090 AN ELECTRON SPIN RESONANCE STUDY OF γ-IRRADIATED SOLID DEXTRAN. Kinell, P.-O.; Lund, A.; Vaenngard, T. (Swedish Research Council Lab., Nykoping). Arkiv Kem., 23, 193-203(1965).

The electron spin resonance spectra from irradiated solid dextran were recorded to study the free radicals produced and to aid in elucidating the mechanism of the structural changes. Spin resonance spectra were recorded after irradiation under various conditions, the yield of free radicals was determined, and in kinetic measurements the change in radical content with time at different temperatures was followed. The amount of hydrogen gas liberated during the irradiation was also determined. Irradiation with ^{60}Co was conducted at 77°K and at room temperature, at a dose rate of 18,000 rad/hr to total absorbed doses of 1 to 2 Mrad. The electron spin resonance spectra were studied at 3- and 1.25-cm wavelengths. The temperature dependence of the resonance structure showed that the spectrum consisted of at least two components. From comparison of spectra it is suggested that direct field effects are important and that at least one strong component has an isotropic hyperfine structure coupling to one α-hydrogen. Various radical structures are discussed. The radical yield at room temperature was 2.8 radicals/100 ev at a total dose of 1.17 Mrad and a dose rate of 1.8×10^4 rad/hr. The yield of hydrogen was, at the same temperature, 2.57 molecules/100 ev. The decay of radicals at higher temperatures was second order. A slower decay with an activation energy of 10 kcal/mole, which was ~first order, was observed at later stages. The frequency factor was about 2 sec^{-1}, which corresponded to an entropy of activation of –10 cal/deg mole when the transmission coefficient was equal to unity. (BBB)

23091 GAMMA-IRRADIATION OF URACIL IN DEAERATED AQUEOUS SOLUTIONS. Khattak, M. N.; Green, J. H. (Univ of New South Wales, Kensington, Australia). Austral. J. Chem., 18: 1847-9(Nov. 1965).

Pyrimidine bases in aqueous solutions in the presence of oxygen when irradiated give high yields of peroxides at the 5–6 double bond, but in the absence of oxygen this destruction of the bases is considerably reduced. A study was made of the products when the base was irradiated in deaerated aqueous solutions. Deaerated solutions (10^{-2}M) were exposed to ^{60}Co γ rays at a dose rate of about 1000 rad/min to total doses of 10^5 to 10^6 rad. The irradiated solutions were then analyzed by paper chromatography. Ultraviolet-absorbing products were located and identified by their R_f values and the uv spectra. Five main radiolysis products of uracil were detected. One product did not show any absorption maximum between 200 and 300 mμ in neutral solution, and when the eluate was acidified and boiled, it showed the same spectrum as uracil. This reversible product was presumed to be 6-hydroxyhydrouracil, resulting from addition of an excited water molecule at the 5–6 double bond or addition of H + OH radicals. With Fink's reagent, three yellow colored spots were found on the chromatograms. These three products had R_f values identical with those from authentic samples of dihydrouracil and cis- and trans-uracil glycols. Confirmation of the glycols was found when the irradiated uracil solution was boiled first with hydrochloric acid and then analyzed; no glycols were found, but isobarbituric acid was observed. Even when the eluates of the glycols were heated to boiling in hydrochloric acid, the resulting solutions showed the same uv spectrum as isobarbituric acid. The formation of this acid was confirmed chromatographically. On the basis of these results, a possible scheme is shown for degradation of uracil in deaerated aqueous solution. When these experiments were repeated with irradiated 2-^{14}C-uracil solution (2 μc/ml), six different radioactive spots were located and identified as the above compounds. (BBB)

23092 EFFECT OF ULTRAVIOLET IRRADIATION ON COLLAGEN-FOLD FORMATION. Cooper, D. R.; Davidson, R. J. (Rhodes Univ., Grahamstown, South Africa). Biochem. J., 98: 655-61(Mar. 1966).

A study was made of the effect of uv-irradiation, in the presence of air and nitrogen, on the conformational changes taking place in cooled solutions of gelatin prepared from thermally denatured neutral-salt-soluble collagen. The increase in negative rotation and viscosity at 15° for irradiated and thermally denatured solutions of collagen became less as the irradiation time was increased. The principal effect of uv-irradiation was the fission of the primary collagen peptide chains, eventually yielding chain lengths incapable of stabilizing a helical structure. Irradiation in both air and nitrogen results in a loss of tyrosine, histidine and phenylalanine, with more denaturation occurring in the presence of nitrogen. (auth)

23093 EQUIPMENT FOR IRRADIATION AT HIGH TEMPERATURE. Cubrak, Branislav; Gal, Olga. Bull. Boris Kidrich Inst. Nucl. Sci., 16: 271-5(Oct. 1965).

Equipment was constructed that allows irradiation of samples at a constant temperature, anywhere between 25 to 110°C. The equipment was constructed for a ^{60}Co laboratory source of 250 C, with a dose rate of ~1 Mrad/hr in the central cavity. The equipment consisted of a heater incorporated in the can and a system for measuring and maintaining a constant temperature. The heater is made of Canthal wire wound around several layers of mica. It is covered with an aluminum and titanium oxide film about 1 mm thick increasing its stiffness and acting as an insulator. The temperature is maintained by a limiter-switch that turns the heater on and off within the temperature range. The procedure during irradiation is described. (F.J.H.)

23094 USE OF PLASTOMERS AND ELASTOMERS IN ATOMIC ENGINEERING. Puig, J. R. Bull. Inform. Sci. Tech. (Paris), No. 98, 53-67(Nov. 1965). (In French).

The various physico-chemical laws governing the behavior of macromolecular substances under nuclear irradiation are reviewed. Illustrations and numerical data define the radiochemical character of the various elastic or plastic materials likely to be used in nuclear and radiochemical engineering. Examples are given and discussed of possible nuclear applications such as joints, coatings, isolation materials, protective screens, etc. (auth)

23095 NUCLEAR RECOIL REACTIONS IN CYCLOPENTADIENYLMANGANESE TRICARBONYL. Costea, T. (Inst. of Atomic Physics, Bucharest); Negoescu, Irina; Vasudev, P.; Wiles, D. R. Can. J. Chem., 44: 885-94(Apr. 15, 1966).

The first stages in an intensive study of Szilard–Chalmers recoil reactions in a covalent metal-organic compound are described. Radioactive ^{56}Mn was found, as expected, as inorganic manganese (75 to 80%), as the parent compound (12 to 20%), and as one or other of two hitherto unidentified, unstable compounds depending on whether anhydrous paper chromatography or paper ionography was used as the separation method (5 to 7%). Some data are given showing the effect of room-temperature annealing following irradiation at -196°C. In particular, the yield of one of the unidentified compounds increases markedly (to ~15%), while that of the other compound remains nearly unaffected. Thin-layer chromatography in anhydrous benzene was used as separation method in thermal annealing studies. The apparent retention increased considerably and then decreased again as annealing continued. The annealing reaction at two temperatures in the liquid and one in the solid phase were qualitatively very similar. These results are interpreted as indicating the presence of another species, the "pseudo-parent," which was not distinguished chromatographically from the parent. Some discussion is given as to possible mechanisms. (auth)

23096 ABSORPTION SPECTRA OF HCCl AND DCCl. Merer, A. J.; Travis D. N. (National Research Council of Canada, Ottawa). Can. J. Phys., 44: 525-47(Mar. 1966). (NRC-8815).

A long progression of absorption bands appearing in the region 5 500–8 200 Å was observed in the flash photolysis of dibromochloromethane, $HCClBr_2$. Observation of chlorine and deuterium isotope shifts, together with the results of the rotational analyses showed that the carrier of the bands is the chloromethylene radical, HCCl. The ground state of HCCl is a $^1A'$ state in which the molecule has an equilibrium angle of ~103°, a C–H bond length of 1.12 Å, and a C–Cl bond length of 1.69 Å. In the upper state, of character $^1A''$, unusual patterns of the vibrational and K-type rotational energy levels indicate that the molecule, although bent, has a low barrier to linearity and is easily "straightened" by vibration. The vibrational levels of the upper state may be fitted quite accurately, using a potential function for the bending vibration of the type suggested by Thorson and Nakagawa (1960); calculations show that the equilibrium angle in the upper state is ~135° and that the top of the barrier lies 2,250 cm^{-1} above the lowest vibrational level. The large change of angle in the transition causes the appearance of subbands with $\Delta K = 0$ and –2 in addition to those allowed by the strict type-C selection rules. The intensities of the forbidden subbands are well explained by the axis-switching mechanism suggested by Hougen and Watson (1965). (auth)

23097 EFFECT OF GASEOUS ADDITIVES ON THE REACTION BETWEEN CARBON DIOXIDE AND GRAPHITE INDUCED BY VACUUM ULTRAVIOLET RADIATION. Feates, F. S.; Sach, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). Carbon, 3: 261-7(Dec. 1965).

The rate at which graphite is gasified on exposure to photolyzed (1165 and 1236 Å) carbon dioxide was reduced by addition of 0.1 vol % methane. An interpretation is proposed involving the decomposition of methane into methyl and methylene radicals, which subsequently react with the graphite surface. The addition of other sources of methylene or methyl radicals (diazomethane, ketene, azomethane, and acetone) also reduce carbon gasification. Acetylene, ethylene, and nitric oxide inhibit oxidation by gas-phase scavenging of oxygen atoms. (auth)

23098 A NOTE ON THE DISAPPEARANCE OF RADICALS TRAPPED IN GAMMA-IRRADIATED STARCH AND GLUTEN. Lee, C. C.; Chen, Ching-hong (Univ. of Saskatchewan, Saskatoon, Can.). Cereal Chem., 42: 573-6(Nov. 1965).

Dried starch and dried gluten, starch with 5.7% moisture, and gluten with 6.5% moisture were irradiated with 10^6 rad of ^{60}Co γ rays. The shape of the electron paramagnetic resonance (EPR) spectrum of the irradiated wheat starch was very similar to that of corn starch reported earlier. The integrated absorption curve suggested an overlapping doublet. The EPR absorption of the irradiated vital gluten showed much lower intensity, and the integrated spectrum was a less resolved broad singlet. The spectrum of irradiated flour showed more resemblance to that of starch than that of gluten. Radical concentrations at various times after irradiation were determined. Disappearance of radicals was followed for long periods, and the plots of $1/(a-x)$ vs t showed that deviations from linearity occurred in the latter stages of radical decay. From the linear part of these graphs, the slopes were 0.11×10^{-18}, 1.7×10^{-18}, 2.2×10^{-18}, and 12×10^{-18} ml $spin^{-1}$ day^{-1}, which were equivalent to initial second-order specific rate constants of 0.77×10^{-3}, 12×10^{-3}, 15×10^{-3}, and 84×10^{-3} 1 $mole^{-1}$ sec^{-1} for the dried starch, moist starch, dried gluten, and moist gluten, respectively. In the latter stages, the disappearance of radicals in starch was greatly accelerated; whereas in the gluten, a residual small concentration of radicals remained essentially constant for a long period of time. These results can be explained on the basis of the mechanism wherein the second-order disappearance of the trapped radicals after irradiation likely is not due to recombination, but may be attributable to reactions with species capable of destroying radicals such as water or the hydroxyl groups of carbohydrates. In irradiated gluten, the initial concentrations of trapped radicals are lower than in starch and these relatively low concentrations of radicals first undergo rapid reactions with accessible groups capable of causing destruction of radicals. However, after the initial reactions, the environment of the irradiated gluten had to be such that a residual small amount of radicals remained relatively stable because, unlike starch, there is no preponderance of hydrogen-donating groups in gluten to cause total destruction of the radicals, some of which may be produced in the inaccessible interior parts of the protein molecules. (BBB)

23099 ISOTOPE EFFECT IN HYDROGEN FORMATION BY THE REACTION BETWEEN TWO AQUATED ELECTRONS. Anbar, M.; Meyerstein, D. (Weizmann Inst. of Science, Rehovoth, Israel. Soreq Nuclear Research Centre, Rehovoth, Israel). Chem. Commun., No. 3, 57-8(Feb. 9, 1966).

The H/D isotope effect involved in hydrogen formation from the photolysis of hydroxide solutions in D_2O-H_2O mixtures was measured. Aquated electrons were produced in alkaline solution (pH = 14), containing 0.025M CD_3OH, by ultraviolet light at 185 mμ and 25°C. CD_3OH was used as an

dioinduced polymerization of trifluorochloroethylene in Cl-containing solvents and in the pure monomer, of the radio-induced polymerization of tetrafluoroethylene in various media, and of the radioinduced copolymerization of various fluoroolefins. The source used was a ^{60}Co source with an activity of 5000 g-equiv of radium. (G.O.Y.)

23086 (AEC-tr-6406/1, pp 219-25) THE K-60,000 GENERAL-PURPOSE RADIOCHEMISTRY TEST AND MODELING INSTALLATION CONTAINING A ^{60}Co RADIATION SOURCE WITH AN ACTIVITY OF 60,000 g-equiv. OF RADIUM. Breger, A. Kh.; Osipov, V. B.; Gol'din, V. A. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The design, operation, and testing of an installation that was developed for the investigation of radiochemical methods and processes are discussed. (D.C.W.)

23087 (AEC-tr-6466/1, pp 238-41) CROSS-LINKING OF TEFLON AND OTHER POLYMERS BY THE LOCALIZED ACTION OF NEUTRON RADIATION. Barkalov, I. M.; Gol'danskii, V. I.; Dzantiev, B. G.; Egorov, E. V. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Localized radioinduced cross-linking of polystyrene and teflon, polymethylmetacrylate and polystyrene, and polymethylmetacrylate and teflon was effected by immersing the materials in solutions of boron- or lithium-containing compounds prior to irradiation with thermal neutrons. Neutron reactions with the boron or lithium in the surface layer limited the action of the radiation to the vicinity of the surface. (D.C.W.)

23088 (AEC-tr-6466/1, pp 242-4) THE USE OF NUCLEAR RADIATION IN THE CHLORINATION OF BENZENE TO YIELD HEXACHLORANE. Krasnousov, L. A.; Zimakov, P. V.; Volkova, E. V.; Belikov, V. M. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The results of an investigation of the radioinduced chlorination of benzene to yield hexachlorocyclohexane are summarized, and a fully automated system for the production of hexachlorocyclohexane is proposed. (D.C.W.)

23089 INVESTIGATIONS IN THE FIELD OF RADIATION-INDUCED SOLID STATE POLYMERIZATION. [PART] XIV. THE γ-RADIATION-INITIATED POLYMERIZATION OF ALLYL PALMITATE. Hardy, Gy.; Nagy, L.; Cser, F. (Research Inst. for the Plastics Industry, Budapest). Acta Chim. Acad. Sci. Hung., 47: 211-19(1966).

The kinetic character of the radiation polymerization of allyl palmitate is linear in both the solid and the liquid states. The rates of polymerization in the solid state, represented as functions of the temperature, showed a maximum near the melting point. Degradative chain transfer, which is characteristic of allylic compounds, played a part in both the liquid and solid-state polymerizations. Polymerization proceeded in both phases according to a radical mechanism. The system p-benzoquinone-allyl palmitate had an extreme eutectic when it contained 7.6 mole % of p-benzoquinone. On the basis of the results of x-ray diffraction studies, an interpretation is presented to account for the particular activity of radical inhibitors in the solid-state polymerization of monomers containing long-chain aliphatic substituents. (auth)

23090 AN ELECTRON SPIN RESONANCE STUDY OF γ-IRRADIATED SOLID DEXTRAN. Kinell, P.-O.; Lund, A.; Vaenngard, T. (Swedish Research Council Lab., Nykoping). Arkiv Kem., 23, 193-203(1965).

The electron spin resonance spectra from irradiated solid dextran were recorded to study the free radicals produced and to aid in elucidating the mechanism of the structural changes. Spin resonance spectra were recorded after irradiation under various conditions, the yield of free radicals was determined, and in kinetic measurements the change in radical content with time at different temperatures was followed. The amount of hydrogen gas liberated during the irradiation was also determined. Irradiation with ^{60}Co was conducted at 77°K and at room temperature, at a dose rate of 18,000 rad/hr to total absorbed doses of 1 to 2 Mrad. The electron spin resonance spectra were studied at 3- and 1.25-cm wavelengths. The temperature dependence of the resonance structure showed that the spectrum consisted of at least two components. From comparison of spectra it is suggested that direct field effects are important and that at least one strong component has an isotropic hyperfine structure coupling to one α-hydrogen. Various radical structures are discussed. The radical yield at room temperature was 2.8 radicals/100 ev at a total dose of 1.17 Mrad and a dose rate of 1.8×10^4 rad/hr. The yield of hydrogen was, at the same temperature, 2.57 molecules/100 ev. The decay of radicals at higher temperatures was second order. A slower decay with an activation energy of 10 kcal/mole, which was ~first order, was observed at later stages. The frequency factor was about 2 sec^{-1}, which corresponded to an entropy of activation of −10 cal/deg mole when the transmission coefficient was equal to unity. (BBB)

23091 GAMMA-IRRADIATION OF URACIL IN DEAERATED AQUEOUS SOLUTIONS. Khattak, M. N.; Green, J. H. (Univ of New South Wales, Kensington, Australia). Austral. J. Chem., 18: 1847-9(Nov. 1965).

Pyrimidine bases in aqueous solutions in the presence of oxygen when irradiated give high yields of peroxides at the 5−6 double bond, but in the absence of oxygen this destruction of the bases is considerably reduced. A study was made of the products when the base was irradiated in deaerated aqueous solutions. Deaerated solutions (10^{-2}M) were exposed to ^{60}Co γ rays at a dose rate of about 1000 rad/min to total doses of 10^5 to 10^6 rad. The irradiated solutions were then analyzed by paper chromatography. Ultraviolet-absorbing products were located and identified by their R_f values and the uv spectra. Five main radiolysis products of uracil were detected. One product did not show any absorption maximum between 200 and 300 mμ in neutral solution, and when the eluate was acidified and boiled, it showed the same spectrum as uracil. This reversible product was presumed to be 6-hydroxyhydrouracil, resulting from addition of an excited water molecule at the 5−6 double bond or addition of H + OH radicals. With Fink's reagent, three yellow colored spots were found on the chromatograms. These three products had R_f values identical with those from authentic samples of dihydrouracil and cis- and trans-uracil glycols. Confirmation of the glycols was found when the irradiated uracil solution was boiled first with hydrochloric acid and then analyzed; no glycols were found, but isobarbituric acid was observed. Even when the eluates of the glycols were heated to boiling in hydrochloric acid, the resulting solutions showed the same uv spectrum as isobarbituric acid. The formation of this acid was confirmed chromatographically. On the basis of these results, a possible scheme is shown for degradation of uracil in deaerated aqueous solution. When these experiments were repeated with irradiated 2-^{14}C-uracil solution (2 μc/ml), six different radioactive spots were located and identified as the above compounds. (BBB)

23092 EFFECT OF ULTRAVIOLET IRRADIATION ON COLLAGEN-FOLD FORMATION. Cooper, D. R.; Davidson, R. J. (Rhodes Univ., Grahamstown, South Africa). Biochem. J., 98: 655-61(Mar. 1966).

A study was made of the effect of uv-irradiation, in the presence of air and nitrogen, on the conformational changes taking place in cooled solutions of gelatin prepared from thermally denatured neutral-salt-soluble collagen. The increase in negative rotation and viscosity at 15° for irradiated and thermally denatured solutions of collagen became less as the irradiation time was increased. The principal effect of uv-irradiation was the fission of the primary collagen peptide chains, eventually yielding chain lengths incapable of stabilizing a helical structure. Irradiation in both air and nitrogen results in a loss of tyrosine, histidine and phenylalanine, with more denaturation occurring in the presence of nitrogen. (auth)

23093 EQUIPMENT FOR IRRADIATION AT HIGH TEMPERATURE. Cubrak, Branislav; Gal, Olga. Bull. Boris Kidrich Inst. Nucl. Sci., 16: 271-5(Oct. 1965).

Equipment was constructed that allows irradiation of samples at a constant temperature, anywhere between 25 to 110°C. The equipment was constructed for a ^{60}Co laboratory source of 250 C, with a dose rate of ~1 Mrad/hr in the central cavity. The equipment consisted of a heater incorporated in the can and a system for measuring and maintaining a constant temperature. The heater is made of Canthal wire wound around several layers of mica. It is covered with an aluminum and titanium oxide film about 1 mm thick increasing its stiffness and acting as an insulator. The temperature is maintained by a limiter-switch that turns the heater on and off within the temperature range. The procedure during irradiation is described. (F.J.H.)

23094 USE OF PLASTOMERS AND ELASTOMERS IN ATOMIC ENGINEERING. Puig, J. R. Bull. Inform. Sci. Tech. (Paris), No. 98, 53-67(Nov. 1965). (In French).

The various physico-chemical laws governing the behavior of macromolecular substances under nuclear irradiation are reviewed. Illustrations and numerical data define the radiochemical character of the various elastic or plastic materials likely to be used in nuclear and radiochemical engineering. Examples are given and discussed of possible nuclear applications such as joints, coatings, isolation materials, protective screens, etc. (auth)

23095 NUCLEAR RECOIL REACTIONS IN CYCLOPENTADIENYLMANGANESE TRICARBONYL. Costea, T. (Inst. of Atomic Physics, Bucharest); Negoescu, Irina; Vasudev, P.; Wiles, D. R. Can. J. Chem., 44: 885-94(Apr. 15, 1966).

The first stages in an intensive study of Szilard–Chalmers recoil reactions in a covalent metal-organic compound are described. Radioactive ^{56}Mn was found, as expected, as inorganic manganese (75 to 80%), as the parent compound (12 to 20%), and as one or other of two hitherto unidentified, unstable compounds depending on whether anhydrous paper chromatography or paper ionography was used as the separation method (5 to 7%). Some data are given showing the effect of room-temperature annealing following irradiation at -196°C. In particular, the yield of one of the unidentified compounds increases markedly (to ~15%), while that of the other compound remains nearly unaffected. Thin-layer chromatography in anhydrous benzene was used as separation method in thermal annealing studies. The apparent retention increased considerably and then decreased again as annealing continued. The annealing reaction at two temperatures in the liquid and one in the solid phase were qualitatively very similar. These results are interpreted as indicating the presence of another species, the "pseudo-parent," which was not distinguished chromatographically from the parent. Some discussion is given as to possible mechanisms. (auth)

23096 ABSORPTION SPECTRA OF HCCl AND DCCl. Merer, A. J.; Travis D. N. (National Research Council of Canada, Ottawa). Can. J. Phys., 44: 525-47(Mar. 1966). (NRC-8815).

A long progression of absorption bands appearing in the region 5 500–8 200 Å was observed in the flash photolysis of dibromochloromethane, $HCClBr_2$. Observation of chlorine and deuterium isotope shifts, together with the results of the rotational analyses showed that the carrier of the bands is the chloromethylene radical, HCCl. The ground state of HCCl is a $^1A'$ state in which the molecule has an equilibrium angle of ~103°, a C–H bond length of 1.12 Å, and a C–Cl bond length of 1.69 Å. In the upper state, of character $^1A''$, unusual patterns of the vibrational and K-type rotational energy levels indicate that the molecule, although bent, has a low barrier to linearity and is easily "straightened" by vibration. The vibrational levels of the upper state may be fitted quite accurately, using a potential function for the bending vibration of the type suggested by Thorson and Nakagawa (1960); calculations show that the equilibrium angle in the upper state is ~135° and that the top of the barrier lies 2,250 cm^{-1} above the lowest vibrational level. The large change of angle in the transition causes the appearance of subbands with $\Delta K = 0$ and –2 in addition to those allowed by the strict type-C selection rules. The intensities of the forbidden subbands are well explained by the axis-switching mechanism suggested by Hougen and Watson (1965). (auth)

23097 EFFECT OF GASEOUS ADDITIVES ON THE REACTION BETWEEN CARBON DIOXIDE AND GRAPHITE INDUCED BY VACUUM ULTRAVIOLET RADIATION. Feates, F. S.; Sach, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). Carbon, 3: 261-7(Dec. 1965).

The rate at which graphite is gasified on exposure to photolyzed (1165 and 1236 Å) carbon dioxide was reduced by addition of 0.1 vol % methane. An interpretation is proposed involving the decomposition of methane into methyl and methylene radicals, which subsequently react with the graphite surface. The addition of other sources of methylene or methyl radicals (diazomethane, ketene, azomethane, and acetone) also reduce carbon gasification. Acetylene, ethylene, and nitric oxide inhibit oxidation by gas-phase scavenging of oxygen atoms. (auth)

23098 A NOTE ON THE DISAPPEARANCE OF RADICALS TRAPPED IN GAMMA-IRRADIATED STARCH AND GLUTEN. Lee, C. C.; Chen, Ching-hong (Univ. of Saskatchewan, Saskatoon, Can.). Cereal Chem., 42: 573-6(Nov. 1965).

Dried starch and dried gluten, starch with 5.7% moisture, and gluten with 6.5% moisture were irradiated with 10^6 rad of ^{60}Co γ rays. The shape of the electron paramagnetic resonance (EPR) spectrum of the irradiated wheat starch was very similar to that of corn starch reported earlier. The integrated absorption curve suggested an overlapping doublet. The EPR absorption of the irradiated vital gluten showed much lower intensity, and the integrated spectrum was a less resolved broad singlet. The spectrum of irradiated flour showed more resemblance to that of starch than that of gluten. Radical concentrations at various times after irradiation were determined. Disappearance of radicals was followed for long periods, and the plots of $1/(a-x)$ vs t showed that deviations from linearity occurred in the latter stages of radical decay. From the linear part of these graphs, the slopes were 0.11×10^{-18}, 1.7×10^{-18}, 2.2×10^{-18}, and 12×10^{-18} ml $spin^{-1}$ day^{-1}, which were equivalent to initial second-order specific rate constants of 0.77×10^{-3}, 12×10^{-3}, 15×10^{-3}, and 84×10^{-3} 1 $mole^{-1}$ sec^{-1} for the dried starch, moist starch, dried gluten, and moist gluten, respectively. In the latter stages, the disappearance of radicals in starch was greatly accelerated; whereas in the gluten, a residual small concentration of radicals remained essentially constant for a long period of time. These results can be explained on the basis of the mechanism wherein the second-order disappearance of the trapped radicals after irradiation likely is not due to recombination, but may be attributable to reactions with species capable of destroying radicals such as water or the hydroxyl groups of carbohydrates. In irradiated gluten, the initial concentrations of trapped radicals are lower than in starch and these relatively low concentrations of radicals first undergo rapid reactions with accessible groups capable of causing destruction of radicals. However, after the initial reactions, the environment of the irradiated gluten had to be such that a residual small amount of radicals remained relatively stable because, unlike starch, there is no preponderance of hydrogen-donating groups in gluten to cause total destruction of the radicals, some of which may be produced in the inaccessible interior parts of the protein molecules. (BBB)

23099 ISOTOPE EFFECT IN HYDROGEN FORMATION BY THE REACTION BETWEEN TWO AQUATED ELECTRONS. Anbar, M.; Meyerstein, D. (Weizmann Inst. of Science, Rehovoth, Israel. Soreq Nuclear Research Centre, Rehovoth, Israel). Chem. Commun., No. 3, 57-8(Feb. 9, 1966).

The H/D isotope effect involved in hydrogen formation from the photolysis of hydroxide solutions in D_2O-H_2O mixtures was measured. Aquated electrons were produced in alkaline solution (pH = 14), containing 0.025M CD_3OH, by ultraviolet light at 185 mμ and 25°C. CD_3OH was used as an

OH radical scavenger to suppress the reaction of OH with H_2. The fate of e^-_{aq} was determined by two competing processes, $e^-_{aq} + e^-_{aq} \rightarrow H_2$; and $e^-_{aq} + H_2O \rightarrow H_2$. The hydrogen atoms formed are converted to e^-_{aq} by the reaction $H + OH^-_{aq} \rightarrow e^-_{aq}$ or they may reset with CD_3OH to give HD. The overall yield of H_2/HD from solutions of CD_3OH in H_2O was dependent on the light intensity. The isotope effects were calculated by comparing the isotopic composition of the evolved hydrogen with that of the water. The H/D isotope effects measured for the $e^-_{aq} + e^-_{aq}$ reaction were 3.9 ± 0.2, 4.7 ± 0.2, and 5.5 ± 0.2 for solutions containing 25, 50, and 75 at. % deuterium, respectively. These values are the lower limits. The observed isotope effect was much higher than expected for the formation of hydrogen by a diffusion-controlled reaction. The H/D isotope effect in the formation of molecular hydrogen was measured at pH = 14 by radiolysis of the same water mixture used in photolysis and found to be 2.3 ± 0.1 at 50% D at 25°C. (F.J.H.)

23100 MECHANISM OF FORMATION OF TRIPLET STATES PRODUCED BY PULSE RADIOLYSIS OF SOLUTIONS OF NAPHTHALENE. Kemp, T. J. (Univ. of Warwick, Coventry, Eng.); Salmon, G. A.; Wilkinson, F. Chem. Commun., No. 3, 73-4(Feb. 9, 1966).

The G-values of naphthalene triplet states (N^T) obtained by pulse radiolysis of solutions of naphthalene in deaerated benzene and cyclohexane are given. The value $\epsilon_{max} = (1.4 \pm 0.3) \times 10^4\ M^{-1}\ cm^{-1}$ was used for the triplet-triplet absorption of naphthalene. The results are compared with previous data and discussed. Observation of $G(N^T)$ of >0.4 in naphthalene-dimethoxyethane (14 mM) supported the conclusion concerning the depressant effect of electron scavengers. (F.J.H.)

23101 ADDITION REACTIONS OF HALOGENATED OLEFINS BY GAMMA IRRADIATION. Matsuda, Tatsuo (Government Industrial Research Inst., Nagoya, Japan). Chem. Ind. (Tokyo), 16: 41-5(July 1965). (In Japanese).

The addition reactions induced by γ irradiation are summarized for combinations of halogenated olefins such as $CCl_2=CCl_2$, $CFCl=CCl_2$, $CFCl=CFCl$, $CF_2=CCl_2$, 1,2-dichlorotetrafluorocyclobutene(I), 1,2-dichlorohexafluorocyclopentene(II), perfluorocyclobutene(III), and various active H-containing compounds such as C_1-C_4 aliphatic alcohols, cyclic ethers (tetrahydrofuran and p-dioxane), Et_2O, C_1-C_3 aliphatic aldehydes, and dialkyl phosphonates. The mixtures of the components were irradiated by ^{60}Co γ rays at total doses up to 4×10^7 R, and the reaction products were purified by distillation. Two types of reaction occur, i.e., $-CX=CX' - +RH^*$ (H^* = active H) → $-CRX-CHX'-$ (type A) and $-CX=CX'- +RH^* \rightarrow -CR=CX' - +HX$ (type B), although the proportions of the two types of the reaction products are widely different. Both types of the reaction products are formed by the reaction of alcohols and $CCl_2=CCl_2$ while the product of type B is not obtained by the reaction of alcohols and $CFCl=CCl_2$ or $CFCl=CFCl$. Trans and cis isomers are isolated from the reaction products of the halogenated cyclic olefins and the alcohols or the aldehydes. Tetrahydrofuran is especially reactive and the yields of its addition products with $CCl_2=CCl_2$, $CFCl=CCl_2$, $CFCl=CFCl$, $CF_2=CCl_2$, and (I) are 84, 89, 84, 65, and 81%, respectively. Et_2O has two active H atoms and 3 or 4 kinds of addition products are produced by its reaction with $CCl_2=CCl_2$ or with (I), respectively. Dialkylchlorofluoroethyl phosphonates are obtained from dialkyl phosphonates and the linear olefins. Most of the addition products obtained in these experiments are new compounds. (tr-auth)

23102 LABORATORY INSTALLATION FOR β IRRADIATION. Cserep, Georg; Foldiak, Gabor; Stenger, Wilhelm (Atomic Energy Commission, Budapest). Chem. Tech. (Leipzig), 18: 101-4(Feb. 1966). (In German).

A β irradiation facility with a divided source was developed using the radioisotopes $^{90}Sr-^{90}Y$. A maximum dose output can be obtained by suitable geometry. The dose output corresponds to that of a ^{60}Co radiation source with activities from 40 to 50 C. This was proved with n-heptane and Fricke dosimetry. The system is also suitable for dynamic measurements and continuous gas or liquid irradiations are possible. Because of its simple operation and relatively low production cost, the device is suitable for laboratory purposes. A single row of lead bricks is sufficient for radiation protection. (tr-auth)

23103 STUDY BY ELECTRON PARAMAGNETIC RESONANCE OF THE RADICALS FORMED BY γ IRRADIATION OF NITRATED COMPOUNDS AT 77°K. Chachaty, Claude (CEN, Saclay, France). Compt. Rend., Ser. C, 262: 680-3(Feb. 28, 1966). (In French).

Gamma irradiation in the solid phase of nitroalkanes in C_1, C_2, and C_3 led, in addition to NO_2, to two types of radicals. The spectra can be interpreted by the localization of the non-paired electron on the nitro group (RNO_2^- or RNO_2H) and on the carbon adjacent to this group ($R-\dot{C}HNO_2$). The spectrum of nitrobenzene irradiated in solution in an organic glass corresponds to $C_6H_5\dot{N}O_2H$. (tr-auth)

23104 STUDY BY ELECTRON PARAMAGNETIC RESONANCE OF THE RADIOLYSIS OF TETRANITROMETHANE AT 77 DEG K. Chachaty, Claude; Rosilio, Charles (CEN, Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. C, 262: 789-92(Mar. 7, 1966). (In French).

The radiolysis of tetranitromethane at 77°K led to the radicals NO_2 and $C(NO_2)_3$. The EPR spectrum of the latter radical indicates a hyperfine coupling of 3.5 G with nitrogen. In vitreous solution in ethanol at 77°K, tetranitromethane intercepts the electrons and the radicals coming from the matrix with the formation of NO_2 by dissociative capture reactions. (tr-auth)

23105 THE DIMERIZATION AND POLYMERIZATION OF SOME DISUBSTITUTED DIENES IN THE CRYSTALLINE STATE UNDER THE EFFECT OF ULTRAVIOLET AND γ RADIATIONS. Chapiro, Adolphe; Lahav, Meir; Schmidt, Gerhardt, M. J. (CNRS, Bellevue, France. Weizmann Inst. of Science, Rehovoth, Israel). Compt. Rend., Ser. C, 262: 872-4(Mar. 14, 1966). (In French).

Under the effects of ultraviolet radiation, some diene acids dimerized in the solid state to give disubstituted cyclobutanes. Some experiments made with trans-trans-muconic acid, and trans-trans-sorbic acid showed that the dimerization does not take place under γ irradiation. It was also found that the polymerization of sorbic acid in the solid state is produced only when the crystalline lattice has been first perturbed by the accumulation of dimer or polymer. (tr-auth)

23106 INVESTIGATIONS IN THE FIELD OF RADIATION-INDUCED SOLID-STATE POLYMERIZATION. XIII. INHIBITION OF THE SOLID-STATE POLYMERIZATION. Hardy, Gy.; Varga, J.; Cser, F.; Detrekoey, E. (Technical Univ., Budapest). Europe. Polym. J.; 2: 41-7(1966).

By measurements on a two-component system, consisting of monomer and an inert additive, a correlation between the laws governing polymerization and the physical state of the system was demonstrated. Examination of the phase diagram proved indispensable in the study of solid-state polymerization in two-component systems. The part played by benzoquinone (BQ), a radical inhibitor, in the solidstate polymerization of N-vinylsuccinimide (NVSI), and the physical state and structure of the system formed, was studied. The phase diagram of the NVSI-BQ system is characterized by simple eutectic formation. It was found, from the phase diagram and x-ray diffraction patterns, that in the liquid phase the components are completely miscible; in the solid phase, they are completely immiscible. In the liquid phase, BQ completely inhibited radioinduced polymerization of NVSI. For the area between the solidus and liquidus (at 40° and low BQ concentrations) polymerization proceeded in spite of the presence of the inhibitor; BQ did not prevent the explosion-like acceleration of NVSI polymerization, but inhibited polymerization once the monomer had melted. When solid-state polymerization kinetics in the region below the solidus (20°) were studied over a wide range of compositions polymerization proceeded even at high BQ concentrations. With higher concentrations of BQ the polymerization rate decreased as the composition approached that of the eutectic and reached a minimum value near the eutectic point. The rate of polymerization did not change when the

concentration of BQ was further raised, and there was no significant change in the retarding action of BQ with lowering of the temperature. The retarding action of BQ and its effect upon molecular weight and the results obtained for the NVSI-PAA system show that the solid-state polymerization of NVSI has a radical mechanism. It was concluded that in two-component systems of NVSI with additives of various chemical types (co-monomers, inert additives, radical inhibitors), the laws of solid-state polymerization can be interpreted on the basis of the decisive role of the crystal surfaces in the initiation of polymerization for monomers polymerizing according to accelerated kinetics. (TCO)

23107 PEROXIDE FORMATION IN GAMMA-IRRADIATED CITRATE BUFFER. Moroson, H.; Nyheim, C. (Sloan-Kettering Inst. for Cancer Research, New York). Experientia, 22: 166-7(1966).

Aqueous solutions of 0.015 M sodium citrate were prepared in triple distilled water and γ-irradiated at zero degrees. Either prepurified nitrogen or oxygen was bubbled through the solution for 30 min prior to and during irradiation. Ultraviolet absorption spectra were determined immediately following irradiation, and the increase in absorbance at 260 nm was recorded as a function of time as well as the entire spectrum. Peroxide analysis was made by KI-starch titration. Results indicated peroxide formation at pH 7 in solutions irradiated in the presence of oxygen. (H.G.D.)

23108 GRAFT COPOLYMERIZATION TO CELLULOSE AND ITS DERIVATIVES. Kraessig, H. A. (Inrescor-International Research Corp., Schwerzenbach, Switzerland); Stannett, V. Fortschr. Hochpolymer.-Forsch., 4: 111-56(1965).

Methods of graft polymerization to cellulose, especially free radical polymerization methods, were surveyed. Grafting and properties of the products were also considered. With adequate swelling, vinyl monomers can be satisfactorily grafted to cellulose and its derivatives. The three main methods are: the direct method wherein the polymer is irradiated in the presence of the monomer vapor, the preirradiation method where the polymer is first irradiated and then brought in contact with the monomer, and the peroxide method in which the polymer is irradiated in air and the resulting polymeric peroxide used to initiate graft polymerization. In heterogeneous grafting to cellulose and its derivatives the dose rate and thickness dependence of the rate of grafting indicated that the reactions are diffusion controlled. The cellulose acetate–styrene system is discussed in detail. Considerable chain scission occurs with the preirradiation method; it is probable that the trapped radicals lead to a cleavage reaction whereas, in the presence of monomer, they add before this can happen. The two-peak molecular weight distribution of the polystyrene side-chains produced by the preirradiation process is different from the mutual product. The 20% of polymer contained in the low-molecular-weight portion has a very broad distribution and is presumably formed from the growth and mutual termination of radical chains present in the more mobile, more accessible regions of the polymer. More than 97% of the radicals are present in this state. The 80% of high-molecular-weight polymer must be due to the slow growth of a very small proportion of radicals, trapped probably in less accessible regions of the film. Since the trapped radicals are all present at the beginning and probably start growing at similar times, this mechanism would account both for the very high molecular weight and the comparatively narrow distribution. (BBB)

23109 SYNTHESIS OF NOBLE GAS COMPOUNDS BY PROTON BOMBARDMENT. MacKenzie, D. R.; Fajer, J. (Brookhaven National Lab., Upton, N. Y.). Inorg. Chem., 5: 699-700(Apr. 1966). (BNL-9780).

The techniques for preparing noble gas compounds using 10-Mev proton beams were studied. Gas mixtures of krypton or xenon and fluorine readily reacted on proton bombardment to yield krypton and xenon fluoride. A 1-hr irradiation, at 5 μa, yielded ~1g of KrF_2. The G values for the formation of the fluorides ranged from 1 to 1.5 molecules/100 ev. KrF_2 was prepared at temperatures as high as −60°C. The yields decreased with increasing temperature. Attempts to prepare the previously reported KrF_2 were unsuccessful. Even at high fluorine to krypton ratios (9:1) only KrF_2 was detected. Also, attempts to prepare XeF_8 by the analogous reaction of XeF_6 with fluorine were unsuccessful. The window of the cell blew out during bombardment of oxygen and xenon at −196°C. The reaction and the explosion were presumably due to the unstable xenon trioxide. All the noble gas fluorides previously reported were synthesized, with the exception of KrF_4 and XeF_8. (F.J.H.)

23110 DIMENSIONAL STABILIZATION OF WOOD. I. IMPREGNATION WITH METHYL METHACRYLATE AND SUBSEQUENT POLYMERIZATION BY MEANS OF GAMMA RADIATION. Gibson, E. J.; Laidlaw, R. A.; Smith, G. A. (Forest Products Research Lab., Aylesbury, Eng.). J. Appl. Chem. (London), 16: 58-64(Feb. 1966).

The dimensional stabilization of timber by impregnation with methyl methacrylate and polymerization by γ radiation was studied. Treatment with pure monomer yielded a product wherein the voids in the wood were filled with homopolymer, but introduction of the monomer in a solvent that swells wood enabled the methacrylate to penetrate the cell walls, giving a product that was not entirely extractable with polymer solvents such as chloroform. Both methods gave products with improved strength and stability, but it is shown that, at low polymer loadings, use of a swelling solvent for impregnation caused some breakdown of the more ordered regions of the cell wall, and could lead to swelling greater than that of the untreated wood. There was evidence to suggest that, if graft copolymerization is achieved at all under these conditions, it may be to the lignin rather than to the carbohydrate portions of the wood. (auth)

23111 GAMMA IRRADIATION OF INDIVIDUAL AND MIXED ION EXCHANGE RESINS. Baumann, Elizabeth W. (E. I. du Pont de Nemours and Co., Aiken, S. C.). J. Chem. Eng. Data, 11: 256-60(Apr. 1966). (TID-22283).

The effects of gamma radiation were investigated for individual and mixed ion exchange resins of the sulfonic acid and quaternary ammonium types. At the maximum dose of 2×10^8 rad, fractional loss of exchange sites was independent of mixing: less than 10% for the hydrogen form and about 50% for the hydroxyl form. Water-soluble products were released from irradiated individual resins, but not from mixed H-OH resins, because each resin retained ionic degradation products of the other, thereby depleting usable exchange capacity. Mixed Li-OH resins released water-soluble lithium compounds and anion resin degradation products. The cation exchange resin swelled to 110% of its original wet-packed volume, anion exchange resin shrank to 87%, and the mixed resin shrank even more, to 76%. (auth)

23112 RADIATION CHEMISTRY OF CARBOHYDRATES. PART XVI. THE CONTRIBUTION OF OH RADICALS TO THE RADIOLYSIS OF AQUEOUS SOLUTIONS. Phillips, G. O.; Griffiths, W.; Davies, J. V. (University Coll. of South Wales and Monmouthshire, Cardiff). J. Chem. Soc. (B), 194-200(1966).

Experiments using ^{60}Co γ radiation showed that the radiation degradation of D-glucose is chemically and kinetically different at 5×10^{-4}M and at 5×10^{-2}M. Scavenging experiments using potassium iodide, and the effects of solute concentration on product yields, supported the view that abstraction by ·OH radicals initiates chemical change at $\leq 5 \times 10^{+3}$M. Pulse-radiolysis experiments using 4-Mev electrons showed that there is no significant reaction of e^-(aq) with carbohydrates. A transient species with an absorption maximum at 2600 to 2700 Å was observed on pulsing, which decayed by second-order kinetics within the solute range of 5×10^{-3} to 5×10^{-1}M in solutions saturated with argon and nitrous oxide. Evidence is presented that the transient species is produced as a result of abstraction by the ·OH radical. Complete scavenging of the ·OH occurred at 5×10^{-3}M. The further decomposition of D-glucose at higher concentrations was due to another process, which could involve energy transfer from excited water molecules. (auth)

23113 THE EFFECT OF THE NO RADICAL SCAVENGER ON THE TELOMERIZATION RATE OF C_2H_4 WITH

CCl_3Br AND CCl_4 INDUCED BY GAMMA-RADIATION. Takehisa, Masaaki; Urano, Yokichi (Government Chemical Industrial Research Inst., Tokyo). J. Chem. Soc. Jap., Ind. Chem. Sect., 68: 1214-18(July 1965). (In Japanese).

Reaction rate of the gamma-induced telomerization of C_2H_4 with CCl_3Br and CCl_4 was measured in the presence of NO radical scavenger, in the temperature range of 10 to 70°C, the pressure range of 150 to 600 mm Hg, the dose rate range of 8 to 200 $\times 10^3$ rad/hr, and the NO concentration range of 0 to 1 mole % of C_2H_4. The telomerization rate using pure C_2H_4 was proportional to a half power of the dose rate regardless of reaction conditions; this indicated that the reaction proceeds by free radical chains in nature. With C_2H_4 containing NO, the reaction rate decreased with increase in NO concentration, while the dose rate dependence of the reaction rate was increased with NO concentration. The rate equation covering the experiments and rate constants are given. (auth)

23114 BEHAVIOR OF RADICALS PRODUCED IN GAMMA-IRRADIATED ISOTACTIC POLY-4-METHYL-PENTENE-1 WITH DIFFERENT DEGREES OF TACTICITY. Kusumoto, Naoshi; Shirano, Kenji (Kyushu Univ., Japan). J. Chem. Soc. Jap., Ind. Chem. Sect., 68: 1553-61(Aug. 1965). (In Japanese).

Gamma-irradiated samples of isotactic poly-4-methylpentene-1 with different degrees of tacticity were inspected by an ESR method. At liquid nitrogen temperature the ESR spectra showed an octet line structure for all of the samples. The spectra of the samples having highest tacticity changed markedly with increasing temperature above −60°C, while samples with low crystallinity remained nearly unchanged. The spectrum at low temperatures was found to consist of sextet and partly of octet and odd number hyperfine structure. With increase of the temperature above −60°C, the octet split reversibly into two, and the intensity of odd number hfs relative to the octet increased irreversibly. The radical causing the octet was identified as $-CH_2-\dot{C}(C_4H_9)-CH=C(C_4H_9)-$ in main chains or $H\dot{C}-CH_2-\dot{C}(CH_3)_2$ in side chains. This reversible splitting phenomenon is supposedly related to the thermal motion of the side chains. Another mechanism is discussed taking into account the results of gas chromatography and intrinsic viscosity measurements. (auth)

23115 RADIOLYSIS OF CRYSTALLINE ALKALINE EARTH BROMATES BY ^{60}Co γ RAYS. Chase, J. W.; Boyd, G. E. (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 70: 1031-7(Apr. 1966). (ORNL-P-1565).

The anhydrous crystalline alkaline earth bromates were radiolyzed by ^{60}Co γ rays to decompositions exceeding 1 mole %. Bromate ion was decomposed to oxygen gas and bromite, hypobromite, and bromide ions, which were observed when the irradiated crystals were dissolved in alkaline aqueous solutions. Evidence was obtained suggesting that BrO_2 also was produced and stabilized in the crystal lattice. The bromate ion decomposition and the yields of oxidizing fragments increased nonlinearly with the dose. Bromide ion and oxygen gas yields increased linearly with dose for small doses, but at larger doses the rate of formation of bromide increased and then became constant, while the rate of oxygen gas production decreased slightly. The bromite ion yield initially was strongly dose dependent, but subsequently it became essentially independent of the dose. The rate of formation of hypobromite ion increased from a vanishingly small value at low doses to a maximum and then approached zero at large doses. The data were consistent with the hypothesis that bromide ion, bromite ion, oxygen gas, and possibly BrO_2 were formed directly by the dissociation of excited BrO_3^- ions, whereas hypobromite and some bromide ions were formed via precursors. Recombination reactions reconstituting bromate ion also occurred. (auth)

23116 RADIOLYSIS AND ENERGY TRANSFER IN THE ADSORBED STATE. Rabe, J. G.; Rabe, Birgit; Allen, A. O. (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 70: 1098-1107(Apr. 1966). (BNL-9513).

The radiolysis of azoethane adsorbed on various solids was studied as an indicator of the energy-transfer processes occurring within the solids and at the surface. On the insulators SiO_2, MgO, and various alkali halides considerable decomposition occurred, which was assumed to result from energy transfer to the adsorbed molecules. The semiconductors ZnO, TiO_2, NiO, and graphite gave little or no sensitization, as expected, since the available quantum energy should not be much larger than the band gap. Some phenomena peculiar to the MgO system are described and are attributed to closer coupling between excited states of the solid and of the adsorbed molecules than occurs in other systems. A chemical method is described for determination of the number of negative color centers in an irradiated sample of alkali halide. The decomposition of azoethane occurring on contact with irradiated solids was studied and is discussed. In radiolysis, a considerable decrease in yield of decomposition of adsorbed azoethane with increase in the total dose was generally found and was attributed to hindrance of energy transfer by radiation-produced defects. (auth)

23117 COLOR CENTERS AND HYDROGEN−DEUTERIUM EXCHANGE IN γ-IRRADIATED SILICA−ALUMINA CATALYSTS. Shipman, George F. (Socony Mobil Oil Co., Inc., Princeton, N. J.). J. Phys. Chem., 70: 1120-5 (Apr. 1966).

Diffuse reflectance spectroscopy was used to observe the spectrum of a γ-irradiated silica−alumina catalyst. Intense absorption was observed in the range of 200 to 700 mμ. The intensity of the absorption increased steadily with dose up to a dose of about 12×10^{20} ev/g. At doses greater than this only small changes in optical absorption were observed. The H_2-D_2 exchange activity induced by γ irradiation increased in a manner similar to that of the optical absorption. However, experiments in which the γ-irradiated catalyst was treated with O_2 or thermally annealed prior to exchange rate measurements indicated that there is little direct relation between the number of color centers and H_2-D_2 exchange activity. For instance, exposure of a γ-irradiated silica−alumina to 100 torr of O_2 pressure at 25°C did not cause any loss in optical absorption intensity but did reduce the exchange activity sixfold. Thermally annealing the irradiated catalyst at 150°C caused a 22-fold decrease in the optical absorption but did not affect the exchange rate. An attempt was made to measure the number of sites active in the exchange reaction but this was unsuccessful. (auth)

23118 THE EFFECTS OF TEMPERATURE AND PRESSURE ON THE γ-RADIATION-INDUCED ISOMERIZATION OF CYCLOPENTANONE TO 4-PENTENAL IN THE LIQUID PHASE. Dugle, D. C.; Freeman, G. R. (Univ. of Alberta, Edmonton, Can.). J. Phys. Chem., 70: 1256-60(Apr. 1966).

The radio-induced isomerization of cyclopentanone to 4-pentenal in the liquid phase was inhibited by increasing the density of the liquid, either by lowering the temperature or by increasing the pressure. The volume of activation for the overall reaction at 1 atm was 2.4 ml/mole, and it increased with increasing pressure. The effect of temperature, separated from the effect of density, on the isomerization reaction was relatively small. The effects of temperature and pressure on the benzene-sensitized isomerization of cyclopentanone was similar to their effects on the direct radiolysis reaction. (auth)

23119 ELECTRON SPIN RESONANCE SPECTRA OF X-IRRADIATED SINGLE CRYSTALS OF SYN- AND ANTI-p-CHLOROBENZALDOXIME: TRAPPING OF SYN- AND ANTI-IMINOXY RADICALS, AND OF THEIR RADICAL PAIRS. Kashiwagi, Michio; Kurita, Yukio (Toyo Rayon Co. Ltd., Kamakura, Japan). J. Phys. Soc. Jap., 21: 558-9 (Mar. 1966).

The trapping of syn- and anti-iminoxy radicals as well as their radical pairs in x-irradiated single crystals of syn- and anti-p-chlorobenzaldoxime is shown. Typical ESR spectra are given. Each of these spectra consists of two components for the syn-aldoxime and for the anti-aldoxime. The radical derived from the syn-aldoxime is identified as the

syn-iminoxy radical, and the radical from the anti-aldoxime is found to be the anti-iminoxy radical. (J.F.P.)

23120 ^{60}Co γ-RADIATION-INDUCED COPOLYMERIZATION OF ETHYLENE AND CARBON MONOXIDE. Colombo, P.; Kukacka, L. E.; Fontana, J.; Chapman, R. N.; Steinberg, M. (Brookhaven National Lab., Upton, N. Y.). J. Polym. Sci. Pt. A-1, 4: 29-57(Jan. 1966).

The gamma-induced free-radical copolymerization of ethylene and CO was investigated over a wide range of pressure, initial gas composition, radiation intensity, and temperature. At 20°C, concentrations of CO up to 1% retarded the polymerization of ethylene. Above this concentration the rate reached a maximum between 27.5 and 39.2% CO and then decreased. The copolymer composition increased only from 40 to 50% CO when the gas mixture was varied from 5 to 90% CO. A relatively constant reactivity ratio was obtained at 20°C, indicating that CO adds 23.6 times as fast as an ethylene monomer to an ethylene free-radical chain end. For a 50% CO gas mixture, the 23.6 value and the copolymerization rate decreased with increasing temperature to 200°C. The kinetic data indicated a temperature-dependent depropagation reaction. Infrared examination of copolymers indicated a polyketone structure containing $-CH_2-CH_2-$ and $-CO-$ units. The crystalline melting point increased rapidly from 111 to 242°C, as the CO concentration in the copolymer increased from 27 to 50%. Molecular weight of copolymer formed at 20°C, increased with increasing CO, indicating $\overline{M}_n$ values >20,000. Increasing reaction temperature resulted in decreasing molecular weight. Onset of decomposition for a 50% CO copolymer was measured at ≈250°C. (auth)

23121 RADIATION-INDUCED GRAFT POLYMERIZATION OF STYRENE TO POLYVINYL CHLORIDE. Takamatsu, Toshiaki; Shinohara, Kenichi (Inst. of Physical and Chemical Research, Tokyo). J. Polym. Sci. Pt. A-1, 4: 197-214(Jan. 1966).

The radioinduced graft polymerization of styrene to polyvinyl chloride (PVC) was investigated. Relations between the rate of grafting and the dose rate when the polymer is irradiated in liquid monomer or in monomer vapor, and between the rate of grafting and monomer concentration absorbed in the polymer were investigated. The rate of grafting in monomer vapor was found to be far larger than that in liquid monomer. A high rate of grafting in monomer vapor was thought to result from a lower concentration of monomer in PVC during irradiation. An experiment carried out on PVC containing the monomer at various concentrations showed that the rate was largest at a monomer concentration of about 3.5 mole/l and was smaller for higher and lower concentrations. On the assumption that the theory of homogenous homopolymerization can be applied to this grafting reaction, the value of k_p^2/k_t was obtained, where k_p and k_t are propagation constant and termination constant, respectively. The value of k_t increased when the monomer concentration exceeded 3.5 mole/l. This increase of k_t can be accounted for if it is assumed that the monomer absorbed in the polymer works as a plasticizer and increases the molecular motion of the polymer. A measurement of the elastic modulus of PVC containing the monomer at various concentrations showed that this is the case. (auth)

23122 INFLUENCE OF DOSE RATE ON RADIATION-INDUCED NETWORK FORMATION IN POLYETHYLENE TEREPHTHALATE. Turner, D. T. (Research Triangle Inst., Durham, N. C.); Pezdirtz, George F.; Sands, George D. Contract NASI-3183. J. Polym. Sci. Pt. A-1, 4: 252-4(Jan. 1966).

Biaxially oriented polyethylene terephthalate (PET) (M_n ~15,000) of 50% crystallinity was degassed in vacuo for 72 hr at 50°C and then sealed in glass tubes at about 10^{-6} torr. The tubes were exposed to either electrons or gamma rays at ambient temperature or with water cooling. Polymer samples were dissolved in ortho-chlorophenol by heating at 90°C for 16 hr and then the limiting viscosity numbers, [−η], were determined at 25°C by extrapolation of three or more values of η_{sp}/c to zero concentrations. The carboxyl groups were determined, following dissolution of the polymer in hot benzyl alcohol, by titration with sodium hydroxide. It was concluded that the ratio of cross-links to fractures, as judged qualitatively from the value of [η], increases with dose rate. The yield of fractures, as diagnosed on the reasonable assumption that the –COOH groups are endgroups, decreased with dose rate. There was relatively little difference between the effects of electrons and gamma rays. (F.J.H.)

23123 POLYMERIZATION OF STYRENE BY IRRADIATION WITH SHORT PULSES OF FAST ELECTRONS. Schneider, Christel (Univ., Cologne); Swallow, A. J. J. Polym. Sci., Pt. B, 4: 277-82(Apr. 1966).

Radioinduced polymerization of styrene by short pulses of fast electrons is described. The absorption spectra of styrene immediately after a 2-μsec pulse, and 1 msec later are shown. The absorption maximum of the transient was at 315 ± 5 mμ. Two oscilloscope traces show the changes in optical transmission at 315 and 400 mμ. The absorption at 315 mμ was stable for at least some seconds, indicating the formation of a very long-lived intermediate or a permanent product. The species at 400 mμ was short-lived, with a half life of about 5 μsec. Experiments were also carried out with dilute solutions of styrene in various solvents. Polystyrene was also found to be the main product in all pulsed solutions of styrene. A 1:1 molar mixture of styrene and methyl methacrylate was pulsed at dose rates of 500 and 5000 rads/pulse. A copolymer was formed whose composition was found by elemental analysis to be 50.2% styrene, 49.8% methyl methacrylate, and 50% styrene, 50% methyl methacrylate, respectively. A double-logarithmic plot of the amount of polystyrene against the dose rate gave a dose rate exponent of ~0.68, while the dependence of the molecular weight on the dose rate was inversely proportional to the square root. It was concluded that the polymerization of pure liquid styrene under pulsed irradiation follows a radical mechanism. (F.J.H.)

23124 INFLUENCE OF THE EXPOSURE-TEMPERATURE ON GAMMA-RAY SENSITIVITY IN NUCLEAR EMULSIONS. Kawasaki, Masami; Otsu, Takaaki (Government Chemical Industrial Research Inst., Tokyo). J. Soc. Sci. Phot. Jap., 27: 68-74(June 1964). (In Japanese).

The effects of ^{60}Co gamma irradiation on commercial nuclear emulsions were studied at five different temperatures (+50°C, +20°C, 0°C, −10°C and −75°C). The exposed emulsions were developed by ID-19 type developer (1:2) for 15 or 20 minutes at 20°C, and then fixed by sodium ammonium thiosulfate fixer. The fixing time was 30 minutes for 15μ emulsions and 90 minutes for 50μ emulsions. Among the nuclear emulsions used, the cobalt-60 gamma-ray sensitivity of proton-sensitive emulsions lay between several roentgens and several tens of roentgen, and that of the electron-sensitive emulsions was several hundreds of milliroentgen. The reduction of density by temperature change was more pronounced for the proton-sensitive emulsions than for the electron-sensitive ones. For most nuclear emulsions, the maximum sensitivity appeared at 20°C, but in some emulsions it appeared at 0°C or −10°C. (auth)

23125 ELECTRON SPIN RESONANCE SPECTRUM OF CYANOACETIC ACID BY γ-RAY IRRADIATION. Kuo, Te-liang. K'o Hsueh T'ung Pao, No. 6, 524-6 (1964).

The electron spin resonance spectrum of a monocrystal of cyanoacetic acid (CA), $CNCH_2COOH$ was studied to determine the coupling of an unpaired electron with the N in the CN group and the structure of CN radical. The monocrystal CA was prepared by slowly evaporating an aqueous solution of CA at room temperature. The crystal obtained had the dimension of a = 3 mm, b = 2.5 mm and c = 5 mm. A ^{60}Co source that provided a dose rate of 222 R/sec was used for irradiation of the monocrystal at room temperature for 5 hours to give a total dosage of 3.99×10^6 R. Subsequent to irradiation the color of the crystal was purple. A Russian EPR-2 paramagnetic resonance spec-

trometer was used for the study. It was concluded that the γ irradiation knocked the H atom from the α carbon of the CA to form a SP^2 mixed orbital and the P orbital was perpendicular to the SP^2 orbital. The C≡N group and the π electron joined to form a larger π electron cloud and reacted directly with ^{14}N to create comparatively large microsplitting of the crystal. (CFSTI)

23126 A STUDY OF THE ELECTRON SPIN RESONANCE OF SULFUR COMPOUNDS WHICH INCREASE THE RADIATION RESISTANCE. Hsin, Wen-chuan; Yao, Min-jen; Chang, Cheng-lien; Hua, Ch'ing-hsin. K'o Hsueh T'ung Pao, No. 12, 1105-7(1964).

The electron spin resonance spectra of organic sulfur compounds mixed with amino acids and proteins and subjected to ionizing radiation was studied. The samples used were dry powdered sulfur compounds mixed with amino acid or protein in a molar ratio of 2:1 and a weight ratio of 1:9, respectively; these mixtures were dissolved in deaerated redistilled water and vacuum-dried at −15°C, becoming so-called molecular mixtures. The mixtures were then irradiated with γ rays from ^{60}Co at room temperature. The status of the basic groups of proteins and amino acids after irradiation was affected by the sulfur compounds in the molecular mixture, while compounds with no sulfur content had no significant effect. It is suggested that the chemical reaction between sulfur compounds and amino acids or proteins may explain their protective effect against radiation damage. (CFSTI)

23127 RADIATION-INDUCED GRAFT COPOLYMERIZATION OF OLEFIN MONOMERS ON POLYPROPYLENE. Chang, Chih-p'ing; T'ang, Jung-pao; Tuan, Ming-ch'un; P'eng, P'ei-li; Wang, Li (Peking Chemical Engineering Research Inst.). Kao Fen Tzu T'ung Hsun, 7: 1-11(1965).

The graft copolymerization of styrene, acrylonitrile, methyl methacrylate, and vinyl acetate in preliminary irradiated polypropylene was studied. Changes of the supramolecular structures of the copolymers and the effects of various experimental conditions on graft copolymerization were also studied. K-1400 ^{60}Co and K-20000 Co were used as radiation sources. Thermomechanical curves of the copolymers were plotted. The strength of the copolymers was determined by a self-recording tensile tester at a constant temperature and an elongation rate of 1 mm/sec. Supramolecular structures were formed by heating the copolymers first to 180°C and then cooling to 80°C in 4 hrs. The growth was observed with a Row polarizing microscope. Grafting of acrylonitrile, methyl methacrylate, and vinyl acetate can be accelerated by raising the temperature beyond 80°C. The activation energies of graft reactions at 70−145°C were found as follows: acrylonitrile 11.5 kcal/mole, styrene 11.8 kcal/mole, methyl methacrylate 10.9 kcal/mole, and vinyl acetate 18.3 kcal/mole. Homo-copolymerization can be reduced but not eliminated by regulating the monomer concentration to 50−60%. The degree of graft is linearly proportional to the radiation dosage, however dosage has no apparent effect on the graft speed. The best dosage for polypropylene was 105 rads. Graft copolymers have desirable dyeing properties, dilatability, and mechanical properties. The mechanical properties of copolymers were directly influenced by the change in supramolecular structure of polypropylene. Large supramolecules split into small supramolecules as the degree of graft increased until a peak value of 4.15% was reached. Irregular supramolecular structure occurred in grafting beyond 16%. (TCO)

23128 REACTIONS IN THE OXIDATIVE DECOMPOSITION OF IRRADIATED PARAFFIN. Neudoerfl, P. (Deutsches Kunststoff-Institut, Darmstadt, Ger.). Kolloid Z., 204: 38-43(July-Aug. 1965). (In German).

Paraffin (mp 68 to 72°C) in blocks 150μ thick and 500μ wide was irradiated at −196°C under vacuum with 50 and 100 Mrad doses from a 1-Mev van de Graaff generator. The molecular weight was found to increase on irradiation; viscosity measurements were used to determine this and the results were graphed. About half of each sample was oxidized with 150 torr O_2 at 0°C. Electron spin resonance spectra were recorded of samples and the structure indicated the usual sextet of the $-CH_2CHCH_2-$ alkyl radical. Above −50°C the concentration of radicals decreased with time because of recombination. ESR studies of oxygenated samples indicated the existence of the peroxide radical. Infrared analysis of the oxygenated samples indicated 35% alcohol, 23% acid, and 42% water. Measurements showed that the reaction followed a chain process leading to hydroperoxy groups. Various mechanisms for the formation of acids, ketones, and aldehydes are discussed. (BBB)

23129 INVESTIGATIONS IN THE FIELD OF RADIATION-INDUCED SOLID-STATE POLYMERIZATION. XIII. INHIBITION OF THE SOLID-STATE POLYMERIZATION. Hardy, Gyula; Varga, Jozsef; Cser, Ferenc; Detrekoy, Emil. Magyar Kem. Foly., 72: 74-7(Feb. 1966). (In Hungarian).

The solid system of N-vinylsuccinimide and benzoquinone may be characterized by an eutectic composition. When the concentration of the benzoquinone was increased up to the eutectic composition, the rate of the solid-state polymerization decreased proportionally, then, above the eutectic composition, even very high concentrations of benzoquinone failed to produce further changes in the rate of polymerization. This may be explained by the formation of a system with very fine texture, proved by x-ray analysis, having a maximum heterogeneous contacting surface, in which the molecules of the inhibitor may display the greatest inhibiting effect on the surface of the monomer crystals. The N-vinylsuccinimide and phthalic anhydride system has a similar phase diagram. Increasing the quantity of phthalic anhydride resulted in higher rates of the polymerization, i.e., no energy transfer was observable in the heterogenous system containing an aromatic component. (auth)

23130 CHANGES IN THE LATTICE STRUCTURE OF SINGLE CRYSTALS OF HIGH POLYMERS BY IRRADIATION IN THE ELECTRON MICROSCOPE. Orth, H.; Fischer, E. W. (Univ., Mainz). Makromol. Chem., 88: 188-214(1965). (In German).

The effect of electrons accelerated at voltages of 40 to 80 kv on the variations of the lattice structure of polyethylene and polyoxymethylene single crystals was investigated. Thus, the dependence of position, intensity, and line width of the reflections in the electron diffraction pattern on the radiation dose was measured. Similar studies were carried out with paraffin ($C_{28}H_{58}$). From the variation of the line width, it was concluded, that in the case of polyethylene, lattice distortions of the second kind (paracrystalline distortions) are produced by cross-linking between adjacent molecular chains within the lattice. They cause a considerable enlargement of the lattice constants. In the case of paraffin, however, the lattice distortions occur as distortions of the first kind (quasithermal distortions). Measurements on polyoxymethylene led to the same result. Irradiation at higher temperatures in all cases caused accelerated damage to the crystal lattice. Polyethylene crystals could be distinguished by the fact that above a temperature of about 65°C the position of reflections no longer varied continuously as it did at room temperature. During irradiation a second hexagonal lattice modification arose. (BBB)

23131 PHYSICAL CHEMICAL STUDIES ON CELLULOSE ALTERED BY GAMMA RADIATION. Sulser, H.; Mohler, H.; Luethy, H. (Univ. Basel, Switzerland). Mitt. Geb. Lebensmitteluntersuch. Hyg., 55: 264-73(1964). (In German).

Properties of cellulose were investigated as a function of the dose of γ radiation applied. An increase in the sorption isotherm corresponding to changes at higher relative humidity was noted with increasing dose (up to 300 Mrad). The half life for water uptake at 20°C and 55% relative humidity nearly doubled from the normal value after 300 Mrad. The half life for hydrolysis in acid solution was independent of dose. Dyeing capacity for direct dyes was a sensitive test for detecting radiation effects in the range of 10^6 rad, where chemical changes could not be detected easily. Rates of dye sorption were plotted and the % dye uptake after 120 min was charted for doses up to 30 to 38 Mrad. Methylene blue increased from 46 to 77%, rhodamine B was approxi-

mately unchanged, rhodamine BP increased from 47 to 59%, carbide black decreased from 57 to 50%, and direct fast orange decreased from 37 to 15% over this dose range; the first and last are recommended. The results obtained with pure cellulose were related to the softening of vegetable tissue. (BBB)

23132 EXCIMER X-RAY INVESTIGATION. Christophorou, L. G.; Carter, J. G. (Oak Ridge National Lab., Tenn.). Nature, 209: 678-80(Feb. 12, 1966). (ORNL-P-1526).

An investigation is presented on the excimer formation in solutions and in pure liquids under x ray excitation. The binding energy of excimers formed in organic liquids is determined. (B.G.D.)

23133 ENERGY DISSIPATION OF ELECTRON BEAMS IN MATTER. IV. MEASUREMENT OF ELECTRON ENERGY DISSIPATION IN POLYSTYRENE BY USING IONIZATION CHAMBER. Nakai, Yohta; Matsuda, Kohji; Takagaki, Torao; Kimura, Ki-ichi. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 7-11(1964-1965). (In Japanese).

The spatial distributions of energy dissipation of electrons in polystyrene and carbon, which are materials of low atomic number, were obtained experimentally for well-collimated electron beams of a few Mev generated from a Van de Graaff accelerator. It is found that the experiment was generally in agreement with the Spencer theory except in shallow and in very deep penetration such as in metallic foils. The discrepancies between experiments and the theory might be attributable to neglecting the effects of the secondary electrons and of electron straggling in the theory. (auth)

23134 STUDY OF RADIATION CHEMISTRY BY THE MEASUREMENT OF ELECTRIC CONDUCTIVITY. I. Takagaki, Tora; Hayashi, Kanae; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 13-22(1964-1965). (In Japanese).

A method for studying ionic species formed in the γ irradiation processes by electric conductivity measurements is described. By measuring conductance under and immediately after the irradiation and ion drift mobilities, G values for free ion formation and free ion lifetimes were determined experimentally. Some experiments on cyclohexane in a vacuum and in oxygen atmosphere were carried out and the effect of dissolved oxygen in cyclohexane on anion mobility and decay constant was observed. (auth)

23135 STUDIES ON POLYOXYMETHYLENE. II. SMALL-ANGLE X-RAY STUDIES ON POLYOXYMETHYLENE OBTAINED BY RADIATION-INDUCED POLYMERIZATION OF TRIOXANE AND FORMALDEHYDE. Suzuki, Yasuo; Sakurada, Ichiro. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 39-43(1964-1965). (In Japanese).

Polyoxymethylene samples were prepared by radioinduced solid-phase polymerization of trioxane and liquid-phase polymerization of formaldehyde. The solid-phase polymerization was carried out at 35, 45, and 55°C, and the liquid-phase polymerization at –78°C. Small-angle x-ray scattering was studied of these samples. None of these polyoxymethylenes showed a discrete diffraction, which indicates the presence of a long period. When these samples were melted and recrystallized by cooling, they exhibited discrete diffraction patterns of a ring form. In all cases the long periods were 170 Å. (auth)

23136 STUDIES ON POLYOXYMETHYLENE. III. RADIATION EFFECTS ON POLYOXYMETHYLENE FIBERS. Suzuki, Yasuo; Kimura, Fujiko; Yamauchi, Michiyo; Sakurada, Ichiro. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 45-55(1964-1965). (In Japanese).

Delrin and Celcon filament yarns were irradiated with γ rays at a dose rate of 4.5×10^4 r/hr at 25°C both in vacuo and in air to obtain exposure levels of 5×10^5 to $\sim 4.3 \times 10^6$ r. Tensile strength and the elongation were decreased considerably with irradiation dose. For example, when Celcon yarns with a draw ratio of 4.6 were irradiated at 4.3×10^6r in vacuo, relative values for the original yarns were 0.5 for tensile strength and 0.4 for elongation, respectively. The lower the draw ratio, the greater the loss of mechanical properties. No serious effect of atmosphere was observed. The values of tensile strength and elongation of the Delrin yarns irradiated at 100°C were found to be greater than those irradiated at 25°C. The tensile strength and the elongation of Delrin yarns decreased more easily than those of Celcon yarns with irradiation. There was not much change in the wide-angle x-ray diagrams between unirradiated and irradiated Delrin yarns, intensities of discrete small-angle diffraction on the meridian decreased with irradiation. (auth)

23137 EFFECT OF OXYGEN ON RADIATION-INDUCED GRAFT COPOLYMERIZATION. Kimura, Fujiko; Sakurada, Ichiro. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 75-82(1964-1965). (In Japanese).

Graft copolymerization of styrene to cotton was carried out in a sealed glass ampoule at room temperature using ^{60}Co γ rays, in the presence of methanol as a solvent both in vacuo and in air. The grafting occurred without an induction period in vacuo, while a long induction period was observed in air. For grafting in air the consumption of oxygen with the irradiation was quantitatively studied by means of a mass spectroscopy. The concentration of oxygen decreased linearly with irradiation dose, and the G value for the oxygen consumption was found to be about 150. This value was large compared with that for radical formation. The grafting was markedly retarded when oxygen was present in the system but after oxygen was consumed the grafting proceeded smoothly at the same grafting rate as observed for the grafting in vacuo. During the induction period, radicals formed from cellulose, styrene, and methanol reacted preferentially with oxygen molecules to produce some peroxidic compounds, then graft copolymerization started. Polymers obtained before the proper grafting took place are considered to be polymeric styrene peroxide. (auth)

23138 STUDIES ON RADIATION-INDUCED IONIC POLYMERIZATION. I. POLYMERIZATION OF STYRENE IN SOLUTION AT LOW TEMPERATURE. Ueno, Katsuji; Yamaoka, Hitoshi; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 83-91 (1964-1965). (In Japanese).

The radioinduced ionic polymerization of styrene at –78°C was studied in various solvents. Cationic polymerization occurred in methylene chloride, carbon disulfide, ethylbromide, and monofluorotrichloromethane. It was concluded that initiating species are derived neither from the acid formed by radiolysis of solvents nor solely by the proton transfer from solvents. From consideration on the G_i value, a mechanism in which almost of all the energy absorbed in solvent transferred to styrene is supposed. The G_i value obtained assuming no chain transfer was 0.1 to 0.2, which agreed well with G_i of free ion already reported in the literature. The relation between dielectric constant of the solvent and kinetics of the polymerization was as clear as in conventional cationic polymerization. (auth)

23139 STUDIES ON RADIATION-INDUCED IONIC POLYMERIZATION. II. POLYMERIZATION OF ISOBUTENE AND COPOLYMERIZATION OF ISOBUTENE WITH STYRENE AT LOW TEMPERATURE. Ueno, Katsuji; Yamaoka, Hitoshi; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 93-103(1964-1965). (In Japanese).

The radioinduced polymerization and copolymerization of isobutene with styrene were studied in several solvents at –78°C. The rates of polymerization of isobutene in CH_2Cl_2, $CHCl_3$, and n-hexane had similar values, but in CS_2 a higher value was obtained. It was concluded that no relation exists between the dielectric constant and the rate of polymerization. It was supposed that the growing chain is a free ion (G_i = 0.1 to 0.2). Monomer reactivity ratios in the copolymerization of isobutene with styrene appeared to be similar to those obtained in the case of conventional cationic polymerization. The radioinduced polymerization rates for several monomers

in CH_2Cl_2 at –78°C were found to be in the following order: Isobutene > Styrene > p-Methoxystyrene > Isoprene > α-Methylstyrene > Isobutyl vinyl ether > 2-Chloroethyl vinyl ether > β-Propiolactone. (auth)

23140 STUDIES ON RADIATION-INDUCED IONIC POLYMERIZATION. III. POLYMERIZATION OF STYRENE AT ROOM TEMPERATURE. Ueno, Katsuji; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 105-24(1964-1965). (In Japanese).

The radioinduced polymerization of styrene in an extremely dry system was studied at room temperature. Sodium–potassium alloy was used as a drying agent. The kinetics were different from those previously reported in which radical reaction was predominant. A radical mechanism was precluded in a dry system for the following reasons: addition of a small amount of water and ammonia reduced the rate of polymerization (Rp); the activation energy for Rp was nearly zero between –20 and +80°C; and Rp was proportional to (dose rate)$^{0.8\sim1.0}$, while the molecular weight was independent of dose rate. To determine whether the reaction mechanism in a dry system was cationic or anionic, copolymerizations of styrene with α-methylstyrene and with isobutyl vinyl ether were carried out and the results strongly supported the suggestions of a cationic mechanism as well as retardation of Rp by addition of NH_3 and Et_2O. Radical scavengers such as DPPH and O_2 also retarded the polymerization. So the existence of an ion-radical in the initiation step is assumed. In an extremely dry system, G (apparent initiation) was found to have a high value, which may be attributed to a frequent monomer chain transfer. The polymerization mechanism based on free ions is described in detail. (auth)

23141 STUDIES ON RADIATION-INDUCED IONIC POLYMERIZATION. IV. POLYMERIZATION OF STYRENE IN SOLUTION AT ROOM TEMPERATURE. Ueno, Katsuji; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 125-33(1964-1965). (In Japanese).

The radioinduced polymerization of styrene in an extremely dry system was studied in methylene chloride and toluene solutions at room temperature. Under conditions of rigorous drying higher G (–m) values were obtained. Molecular weights of polystyrene formed in methylene chloride were higher than those obtained in bulk polymerization, which suggested a strong confirmation of a cationic mechanism. Polystyrene obtained in methylene chloride at 10°C contained less than 0.3 chlorine atoms per polymer molecular atoms per polymer molecule. In the case of polymerization in toluene, molecular weights of polystyrene decreased with increases in solvent concentration, which can be explained by chain transfer to toluene. (auth)

23142 THE STUDY OF RADIATION CHEMISTRY BY THE MEASUREMENT OF ELECTRIC CONDUCTIVITY. II. Hayashi, Kanae; Takagaki, Torao; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 135-40(1964-1965). (In Japanese).

Ionic species formed by the γ irradiation processes were studied for several hydrocarbons (cyclohexene, benzene, and ethylbenzene) at room temperature (15°C) by the electric conductivity measurements. Ion drift mobilities, decay constants, G values of free ion formation, and lifetimes of the compounds were determined experimentally. Ion drift mobility of the anion was larger than that of cation in vacuum. The relation between electric conductivity and irradiation dose rate was different from that expected by Allen's kinetics. The G value for the relatively low dose rate irradiation was in the order of 10^{-2} to 10^{-3}, in which aliphatic compounds had larger values than aromatics. The lifetimes of free ions were in the order of a second because of their low concentration. (auth)

23143 RADIATION-INDUCED SOLID STATE POLYMERIZATION OF 3,3-BIS(CHLOROMETHYL) OXETANE. Okada, Mitsuo; Nishii, Masanobu; Hayashi, Kanae; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 141-54(1964-1965). (In Japanese).

Radioinduced in-source and post polymerizations of 3,3-bis (chloromethyl) oxetane (BCMO) in the solid state were carried out at various conditions. In the case of in-source polymerization, saturation of polymer yield was observed at the lower temperature polymerization and in presence of air. At 0°C, no saturation phenomenon was observed in either gradually cooled or rapidly cooled samples, but the latter had a very small initial rate of polymerization. In post polymerization, the polymer yield always saturated at very low conversion, which depended largely on the crystalline state of monomer. From the kinetic consideration adopted for the solid-state polymerization of trioxane, the rate constants for propagation and termination and the mean lifetimes of active centers of polymerization were calculated at several temperatures. The results of polymerization under the pulse irradiation of electron beams, u_2v_2 sensitized post polymerization, and G_1 value estimation by the addition of iodine are also described. (auth)

23144 ESR STUDY ON THE MECHANISM OF RADIATION-INDUCED SOLID-STATE POST POLYMERIZATION OF 3,3-BIS(CHLOROMETHYL) OXETANE. Tsuji, Kozo; Hayashi, Kanae; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 155-62 (1964-1965). (In Japanese).

The electron spin resonance spectrum of 3,3-bis(chloromethyl) oxetane irradiated at –196°C was observed at the same temperature. The main spectrum was triplet (coupling constant: 24 gauss) which was superposed by a doublet spectrum (coupling constant: 15 gauss). As temperature was raised, the triplet spectrum disappeared at about –70°C and only the doublet spectrum was observed. It disappeared at about 15°C. A mechanism for radioinduced solid-state post polymerization is proposed. The G-value for formation of radicals ((I)′ or (II)), which showed the doublet spectrum was 3 and the G-value for the initiation calculated from polymerization data was 0.8. The difference between them was attributed to coexistence of radicals to polymerization. (auth)

23145 ESR STUDIES OF IRRADIATED PYRIDINE AND ITS DERIVATIVES. Tsuji, Kozo; Yoshida, Hiroshi; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 163-72(1964-1965). (In Japanese).

Pyridine, Pyridine-d_5, and some derivatives were irradiated with electron beams in the solid state at –196°C. After the irradiation ESR spectra were measured over the range from –196°C to the melting point. A triplet spectrum (splitting 30 gauss) with a quartet substructure (splitting 4.3 gauss) was observed at –196°C. When the temperature was raised the triplet spectrum disappeared and an eight line spectrum (splitting 12 gauss) was observed at –90°C. A singlet spectrum (ΔHmsl 15 gauss) was observed at –65°C and disappeared at about –50°C. It was assigned to pyridyl radical. The radicals produced in irradiated pyridine-d_5 were the same as in the irradiated pyridine. When picolines and vinylpyridines were irradiated, free radicals were observed that may be produced by addition of a hydrogen atom to the pyridine ring or by abstraction of a hydrogen atom from methyl group or pyridine ring. (auth)

23146 ESR STUDIES OF IRRADIATED POLY 3,3-BIS(CHLOROMETHYL) OXETANE. Tsuji; Kozo; Yoshida, Hiroshi; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 173-7(1964-1965). (In Japanese).

Poly 3,3-bis(chloromethyl) oxetane was irradiated with electron beams at –196°C. ESR spectra were measured at various temperatures. A triplet spectrum (coupling constant 21 gauss) was observed at –196°C, which was superposed by a doublet spectrum (coupling constant 18 gauss). As the temperature was raised the triplet spectrum disappeared at about –60°C and only the doublet spectrum was observed. The triplet spectrum was assigned to the free radical $R-CH_2$ produced by abstraction of a chlorine atom from a side group or by main chain scission. The doublet spectrum was assigned to free radicals $R-\dot{C}H-O-$ produced by abstraction of a hydrogen atom from the main chain. In

the case of ultraviolet radiation at −196°C, a triplet spectrum (coupling constant 20 gauss) was also observed, which was assigned to the free radical $R-\dot{C}H_2$ produced by abstraction of a chlorine atom from a side group or by main chain scission. When the irradiated sample was treated at -78°C for the 132 min, the triplet spectrum disappeared and an asymmetric singlet spectrum was observed. (auth)

23147 POLYMERIZATION OF CYCLIC ETHERS IN THE PRESENCE OF MALEIC ANHYDRIDE. IV. FURTHER INVESTIGATION OF THE POLYMERIZATION MECHANISM. **Takakura, Koichi; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 189-96(1964-1965). (In Japanese).**

The polymerizations of cyclic ethers such as trioxane or 3,3-bis(chloromethyl) oxetane initiated by both radiation and benzoyl peroxide (BPO) in the presence of maleic anhydride (MAH) were investigated in detail in order to elucidate the initiation mechanism. When gamma- or UV-irradiated equimolar solutions of a cyclic ether and MAH were added to isobutyl vinyl ether (IBVE), polymerization took place and the resulting polymer was confirmed to be not a copolymer with MAH, but a homopolymer of IBVE. Heated soultion of dioxane, MAH, and a small amount of BPO could initiate the polymerization of IBVE in the same manner. The electric conductivity of 1 : 1 mixture solution of MAH and dioxane increased about ten times after UV irradiation. From these results, it was demonstrated that some cationic species are formed in the system by irradiation or the decomposition of added BPO. The mechanism of the formation of cationic species responsible for the initiation may be explained as follows: the formation of a free radical of an ether occurs at first by abstraction of a hydrogen atom attached to the carbon adjacent to oxygen atom, followed by a one-electron transfer from the resulting radical to MAH, an electron acceptor, to yield the cationic species of the ether, and the anion radical of MAH, respectively. The resulting cationic species as well as the counter anion radical are resonance-stabilized. Therefore, the polymerization may be designed as radical induced cationic polymerization. It was also observed that the usual cationic polymerization of these cyclic ethers was markedly accelerated in the presence of MAH as a solvent. This fact suggested that MAH would participate not only in the initiation, but also in the propagation step of the polymerization. (auth)

23148 CATIONIC POLYMERIZATION OF ISOBUTYL VINYL ETHER AND N-VINYLCARBAZOLE INITIATED BY THE SPECIES DERIVED FROM ETHEREAL MALEIC ANHYDRIDE. **Takakura, Koichi; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 197-204(1964-1965). (In Japanese).**

Polymerizations of isobutyl vinyl ether (IVBE) and N-vinylcarbazole (VCZ) were carried out by the use of the cationic species derived from ethereal maleic anhydride (MAH) as a catalyst. The catalyst systems were prepared as follows: MAH was dissolved in a number of cyclic and chain ethers, and these ethereal solutions were either irradiated in air by γ rays or UV light, or heated in vacuo in the presence of a small amount of benzoyl peroxide, and then were used as a catalyst. Homopolymerization of bulk IBVE and VCZ in solutions readily occurred in air at 30°C on addition of these catalysts. The initiating activities of the active species formed were examined for polymerization of IBVE and VCZ. The higher the concentration of MAH in an ethereal solution, the better initiating activity was observed. However, irradiated MAH alone could hardly initiate such polymerization. Polymerization of VCZ in toluene by the use of an irradiated dioxane-MAH system as catalyst was investigated in detail. (auth)

23149 SYNTHESIS AND POLYMERIZATION OF METHYLTRIOXANES. **Shimizu, Akira; Hayashi, Koichiro; Okamura, Seizo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 215-18(1964-1965). (In Japanese).**

The preparation and polymerization of methyltrioxane (II) and dimethyltrioxane (III) were studied. These trioxane derivatives were synthesized by cotrimerization of formaldehyde and acetaldehyde catalyzed by mineral acid, and the structures were confirmed by elemental analysis, molecular weight measurement, and infrared and NMR spectra measurements. The polymerization of these two monomers was tried by some typical cationic catalysts and γ irradiation. Dimethyltrioxane did not polymerize, but the polymerization of methyltrioxane was observed with boron trifluoride etherate, and led to the solid polymer. (auth)

23150 IONS PRODUCED FROM ALIPHATIC ETHERS BY ELECTRON IMPACT. **Hirota, Kozo; Takezaki, Jun'ichi; Hatada, Motoyoshi. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 247-52(1964-1965). (In Japanese).**

Some of the peaks in the mass spectra of aliphatic ethers were found to be composed of two or three peaks, which differed slightly from each other in their masses. The multiplets observed indicated the presence of more than one ion of nearly the same mass. The doublet at m/e = 29, for example, showed the presence of two ions, CHO^+ and $C_2H_5^+$. Detailed informations on the reactions under electron impact were obtained from the high-resolution mass spectra. (auth)

23151 GASEOUS PRODUCTS FROM THE RADIOLYSIS OF OXYGEN-CONTAINING COMPOUNDS. **Isoya, Toshiro; Hatada, Motoyoshi; Hirota, Kozo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 253-9(1964-1965). (In Japanese).**

The radiolysis of triacetin, glycerin and acetonyl acetone was investigated in order to obtain a correlation between the number of structural units in a molecule and the G values of products. A straight line was found in each series by plotting G values against the number of structural units from these results. (auth)

23152 GASEOUS PRODUCTS FROM THE RADIOLYSIS OF ALIPHATIC HYDROCARBONS. **Isoya, Toshiro; Hatada, Motoyoshi; Hirota, Kozo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 261-8(1964-1965). (In Japanese).**

A relation was obtained from the data of many authors between G values for gaseous products from the compounds, $-(-CH_2-)-_n$, and the number of the structural unit. G values of hydrogen from $-(-CH_2-)-_n$ have a linear relation to 1/n in the region of $n < 5$, and are independent of n in the region of $n > 5$. This finding may be explained by an intramolecular dissipation of energy absorbed, and may be useful to predict the approximate G value of the related compounds. (auth)

23153 EXPERIMENTAL STUDIES OF PULSE RADIOLYSIS: α-METHYLSTYRENE. Katayama, Meiseki; Yamazaki, Hatsuo; Ozawa, Yasutomo; Hatada, Motoyoshi; Hirota, Kozo. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 269-77(1964-1965). (In Japanese).

Detailed descriptions of pulse radiolytic experiments, such as performance of linear accelerators, performance of the flash lamp for photographic recording, arrangement of instruments, etc., are given. Spectrograms of transient absorption observed for α-methylstyrene are also given. (auth)

23154 ESR STUDY OF IRRADIATED ACETONE AT LOW TEMPERATURE. **Nitta, Isamu; Ohnishi, Shun'ichi; Sugimoto, Shun'ichi; Kuwata, Keiji. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 283-94(1964-1965). (In Japanese).**

The ESR spectrum of γ-irradiated acetone at −196°C, which was intensely colored brownish black, was composed of a broad asymmetric singlet with g = 2.002 and additional hfs of a free radical. The color and the ESR signal of the singlet disappeared gradually on illumination with visible light. The effects of illumination with monochromatic light of different wavelengths on the ESR signal were investigated. The changes in spectrum due to the addition of methyl ethyl ketone, carbon tetrachloride, etc., were also determined. From the results obtained, it was deduced that in acetone the trapping of electron occurs and that electrons were the origin of the color and the broad asymmetric singlet in the ESR spectrum. (auth)

23155 ESR STUDY OF IRRADIATED SOLID CYCLOALKENES. Nitta, Isamu; Ohmae, Tadayuki; Ohnishi, Shun-

ichi; Kuwata, Keiji; Sakurai, Hiroshi. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 295-9(1964-1965).

ESR spectra of electron-irradiated solid cycloalkenes are discussed in terms of motional narrowing or structural deformation on warming. The spectra of irradiated cyclopentene, cycloheptene, and cyclooctane were measured at different temperatures. On warming a temperature-dependent motional narrowing was observed. The hyperfine structure in the spectro are shown to be due to the cycloalkenyl radicals. (F.J.H.)

23156 STEREOISOMERIC RADICALS IN IRRADIATED CIS AND TRANS CYCLOHEXANE-1,2-DIOL. Nitta, Isamu; Ohmae, Tadayuki; Ohnishi, Shun-ichi; Kuwata, Keiji; Sakurai, Hiroshi. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 301-6(1964-1965).

Power samples of cis- and trans-cyclohexane-1,2-diol-1 were sealed under vacuum and irradiated at –196°C with electron beams (1.5 Mev, 100 μa) to a dose of 15 Mrad. The ESR spectra were measured at the same temperature. After annealing at –78°C for 2 hr the ESR spectra were measured at room temperature. Changes were observed suggesting that radicals other than cis- and trans-cyclohexane-1,2-diol-1 radicals are present. G-values for the two diol-1 radicals and cyclohexanol-1 radical were determined using DPPH as a standard. On warming the electron-irradiated samples, changes in the spectra were observed for both diol-1 radicals above –30°C. ESR spectra of gamma irradiated cis- and trans-cyclohexane-1,2-diol are shown. The samples were irradiated at 25°C at a dose rate of 6.75×10^5 r/hr. The spectra were measured at 25 and –196°C. (F.J.H.)

23157 GRAFT COPOLYMERIZATION OF ACRYLAMIDE ON AMYLOSE BY THE METHOD OF PREIRRADIATION IN THE AIR. Mishina, Akira; Nikuni, Ziro (Osaka Univ.). Nippon Nogei Kagaku Kaishi, 37: 46-8(1963). (In Japanese).

Amylose was irradiated at 0.3 to 1.8×10^7 R with γ rays at a dose rate of 4×10^4 R/hr, in air at room temperature, then acrylamide solution was added and graft copolymerization was performed in a vacuum at several different temperatures. The irradiated amylose was maintained at 35, 50, and 100°C and the stability of the hydroperoxide produced was examined. At 35°C there was only slight decomposition of hydroperoxide in 330 hr, and at 50°C obvious decomposition occurred. At 100°C the amount of hydroperoxide was reduced to one-half of initial value in 6 hr, and the degree of grafting was also decreased. The presence of ferrous ion in the graft reaction was effective in inhibiting monomer polymerization and other polymerizations, but the yields of grafting and acrylamide copolymerization were decreased. The best conditions found from several graft copolymerization experiments were as follows: 1 g amylose was irradiated with 1.8×10^7 R in the air, and 2 g acrylamide and 15 ml water were added, then heated in vacuum at 50°C for 30 hr. Under these conditions, 0.914 g graft polymer (with 63% amylose and 37% acrylamide) was produced. (BBB)

23158 PHOTOCHEMISTRY OF 1,3-DIMETHYLTHYMINE IN AQUEOUS SOLUTION. Alcantara, Raul; Wang, Shih Yi (Johns Hopkins Univ., Baltimore). Contract AT(30-1)-2798. Photochem. Photobiol., 4: 465-72(June 1965).

Reaction mechanisms and the possible biological importance of the photochemistry of thymine were investigated in a study on the stepwise isolation and identification of the photoproducts from uv irradiation of the model compound, 1,3-dimethylthymine (DMT) in aqueous solution. In addition to N,N′-dimethylmethylmalonamide the following were identified as products when irradiation at 254 mμ produced a 50% decrease in the original uv absorbancy of the solution: ammonia, methylamine, 5-carboxy-1,3-dimethyluracil, acetic acid, formic acid, 5-formyluracil, and formaldehyde. The isolation of 5-formyl-1,3-dimethyluracil (FDMU) as a major photoproduct indicated the possible photooxidation of the 5-methyl group of thymine derivatives. Possible mechanisms of formation of FDMU are considered. FDMU could not result from the oxidation of the starting material in a single step. An intermediate prior to the formation of 5-FDMU must exist. It was concluded that the identification of FDMU and the possible presence of an intermediate may prove important in radiobiology. (BBB)

23159 RADIATION POLYMERIZATION. Chapiro, A. (CNRS, Bellevue, France). Plaste Kautschuk, 11: 451-4 (1964).

A general survey of radiation polymerization is presented, with special reference to the mechanism of 3 main types. The first is radical polymerization; the reaction kinetics are discussed and equations for the rate of polymerization are given. Experiments were carried out with irradiated styrene, methyl methacrylate, methacrylates, vinyl acetate, and acrylonitrile, dissolved in benzene, toluene, methyl acetate, and ethyl acetate. The addition of CCl_4 was found to accelerate the polymerization considerably, acting as a sensitizer. The second type is ionic polymerization. Butadiene and isoprene as well as isobutylene were found to polymerize according to a cationic methanism if they are irradiated at low temperatures. The total activation energy of these reactions is –2 to –3 kcal/mole, and the rate is directly proportional to the radiation dosage. The polymerization was accelerated by the addition of solvents containing halogens such as methylene chloride or 1,1-dichloroethane. The reaction mechanism is discussed and the systems styrene–methyl methacrylate, styrene–acrylonitrile and isobutylene–vinylidene chloride were analyzed. In polymerization of the solid phase, little is known about the mechanism of the reaction. A classification of monomers is suggested based on the variation of the rate of polymerization when changing from the liquid to the solid phase. A number of monomers that do not polymerize in the solid state are listed, including methyl methacrylate, methyl acrylate, vinyl acetate, and vinyl chloride. However, their solid solutions in paraffin can be polymerized by irradiation. A number of other exceptions are discussed. The more perfect the crystals of heterocyclic monomers, such as acrylonitrile, the more readily they polymerize. (CFSTI)

23160 POLYMERIZATION OF VINYL CHLORIDE BY X IRRADIATION. Behrens, H. (Institut fuer Physik und Physikalische Chemie, Leipzig). Plaste Kautschuk, 11: 454-9(1964).

The x-ray polymerization of vinyl chloride from the liquid phase is discussed, and the effects of the x-ray dosage, dosage rate (rad min^{-1}), and temperature on the polymeric product were investigated. X-ray studies of the structure showed that a highly ordered polyvinylchloride can be obtained if the polymer is irradiated for only a short period of time. Prolonged irradiation of the polymer deteriorates the order. Measurements of viscosity and decreasing solubility indicate that this is caused by crosslinking and branching. On the one hand, oxygen inhibits the polymerization, while on the other hand, it seems to exert a stereoregulating effect, i.e., yielding a peroxide compound with vinylchloride radicals. The effects of the x-ray spectral energy distribution on the transformation were also investigated and it appeared that the course of the polymerization is a function of the quality of the radiation. This was substantiated by viscosity measurements. The importance of the Compton effect and the photoelectric effects are also discussed. (CFSTI)

23161 SOME SOLVENT EFFECTS ON THE ^{60}Co GAMMA-RAY-INITIATED POLYMERIZATION OF ISOBUTENE IN THE PRESENCE OF ZINC OXIDE. Bartlett, J. A.; Dalton, F. L. (Wantage Research Lab., Eng.). Polymer, 7: 107-12(Mar. 1966).

n-Hexane was added to isobutene-zinc oxide mixtures in order to study monomer dilution behavior during radio-induced polymerization. The results obtained may be understood within the framework of a previously proposed reaction scheme if Fontana-Kidder type kinetics are assumed for the propagation and transfer reactions of the polymerization. (auth)

23162 ESR STUDY OF γ-IRRADIATED POLYNUCLEOTIDES. Herak, Janko N.; Gordy, Walter (Duke Univ., Durham, N. C.). Proc. Nat. Acad. Sci. U. S., 55: 698-704 (Apr. 1966).

A study is presented on the electron spin resonance of radiation induced homopoly-nucleotides and copolymer nucleotides which are compounds having structure, and in many cases behavior, similar to that of the natural polynucleotides DNA and RNA. (B.G.D.)

23163 DOSIMETRY WITH THE AID OF RADIATION CHEMICAL REACTIONS. Minder, W. (Radium-Institut, Bern). Radiologe, 4: 267-72(Aug. 1964). (In German).

Radiation chemistry dosimetry is based on the measurement of some property that is altered in proportion to the radiation energy absorbed. The changes measured are more accurate than measurement of air ionization and are more directly equivalent to tissue than is a gas. The most important advantage is that using a chemical dosimetry system dosage can be measured in a mixed radiation field. In fields that contain photons and electrons and heavy corpuscular radiation, discrimination can be achieved by addition of an excess of Cu^{2+} ions, which inhibit Fe^{2+} oxidation by radicals almost completely, and permits only small amounts of oxidation by H_2O_2. Dosimetry for ranges as high as 10^6 to 10^7 R depends on Fe oxidation reactions. For ranges above 10^8 R, the Ce(IV) – Ce(III) reaction or the destruction of oxalic acid in aqueous solution can be used. However, for extremely high dose ranges (10^7 to 10^9 R) gaseous nitrogen oxides are useful. Calibration of materials used in dosimetry is an important requirement to establish the relative usefulness of any radiochemical reaction as a standard procedure. The measurement results depend on the energy and type of radiation. The radiochemical changes observed increase with the energy of the radiation, but decrease with increase in the ionization produced in water. (BBB)

23164 INVESTIGATIONS OF THE VELOCITY OF ION EXCHANGE ON STANDARD AND POROUS HIGHLY ACID STYRENE–DIVINYLBENZENE CATIONITES USING A MIXTURE OF THE RADIOISOTOPES ^{90}Sr–^{90}Y AND THE EFFECT OF HIGH γ DOSES ON THE SPEED OF THE ION EXCHANGE. Pesek, Miroslav (Nauchno Issledovatel'skii Institut Sinteticheskikh Smol i Lakov Pardubitse, USSR). pp 274-98 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.2]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965]. (In Czech).

A method was developed by which the velocity of ion exchange in different types of styrene-divinylbenzene acid cationites can be investigated using ^{90}Sr and ^{90}Y. The effect of high ^{60}Co γ doses on measurement of the speed of ion exchange was investigated. From the results obtained the yields decreased under the effect of exposure. These decreases were calculated for different cationites and the relative speeds on standard and porous cationites were compared. (tr-auth)

23165 RADIOLYSIS OF IONIC SOLIDS. Maxim, I. V. (Inst. of Atomic Physics, Bucharest). Studii Cercet. Fiz., 18: 21-50(1966). (In Rumanian).

The behavior of materials under radiation is an important criterion for their selection as a structural component, fuel or cladding material in reactor engineering applications. The radiation-induced improvement of certain parameters and initiation of chemical reactions by radiation is also of great potential interest. Theoretically, radiation allows control of crystal-lattice defects. The radiolysis involves several elementary processes, including interactions with electrons and atoms with nuclei of the lattice. The γ rays interact with the nuclei by means of elastic collisions, with electrons through the Compton effect, the photoelectric effect and pair formation. While thermal neutrons are involved only in nuclear reactions, fast neutrons also act through elastic collisions with the nuclei. Heavy charged particles lose energy through Coulomb interactions. Recombination processes may result in the return to the original state or may form new chemical species. The secondary processes include energy transfer, charge transfer and charge neutralization. The specific cases reviewed include the spontaneous decomposition of salts; radiolysis of salts by external irradiation; behavior of salts with monoatomic cations and polyatomic anions, discussing also the effect of structural defects on the results of the radiolysis. It is concluded that the data available do not allow formation of a clear picture concerning the mechanisms involved in the radiolysis. 130 references. (TTT)

23166 SKELETAL REARRANGEMENT REACTIONS IN SULFIDES, DISULFIDES, SULFOXIDES AND SULFONES UPON ELECTRON IMPACT. Madsen, J. O. (Aarhus Univ., Denmark); Nolde, C.; Lawesson, S.-O.; Schroll, G.; Bowie, J. H.; Williams, D. H. Tetrahedron Lett., No. 49, 4377-80(Dec. 1965).

The rearrangement reactions that occur in certain sulfides (I-V), the disulfides (VI, VII), sulfoxide (VIII), and sulfone (IX) were studied. The compositions of all rearrangement ions were established by mass measurements. Those cases in which the rearrangement fragment is formed in a one-step process from the molecular ion, as indicated by an appropriate metastable peak, are indicated. Generally, the sulfides or disulfides may eliminate a sulfur atom (with or without additional hydrogen atoms) and the terminal groups then combine. The sulfoxide (VIII) and the sulfone (IX) behaved analogously. Additional mass measurements established that rearrangement fragments occur at lower masses, and these may be decomposition products of the primary rearrangement ions, e.g., m/e 153 (7%, $C_{12}H_9^+$) and m/e 152 (8%, $C_{12}H_8^+$) from IX. Although some sulfones are known to rearrange thermally with elimination of sulfur dioxide at relatively high temperatures, the possibility of thermal rearrangement has been excluded in the case of IX by obtaining the spectrum by the direct inlet procedure at 60°C. (BBB)

23167 RADIOLYSIS OF GASEOUS MIXTURES OF METHANE WITH ARGON OR XENON. Hummel, R. W. (Wantage Research Lab., Wantage, Eng.). Trans. Faraday Soc., 62: 59-69(Jan. 1966).

Mixtures of CH_4 with Ar or Xe were irradiated with 4 Mev electrons at ambient temperatures and atmospheric pressure. Variations of the yields of H_2 and low-molecular-weight hydrocarbons with mixture composition are discussed in terms of the reactions of ions and of excited states. Energy transfer from excited Ar atoms to CH_4, resulting in methylene radical and molecular H_2 formation, appears to account for more than half the enhanced yields of H_2 observed in mixtures of Ar and CH_4. Charge transfer processes can account for the rest. The variations in the yields of hydrocarbon products are also consistent with this type of energy transfer mechanism. Evidence for energy transfer from excited Xe atoms to CH_4 is also given. (auth)

23168 RADIOLYSIS OF AQUEOUS SOLUTIONS CONTAINING NITRIC OXIDE AND ALIPHATIC ALCOHOLS. Woodward, T. W.; Sutton, H. C. (Univ. of Edinburgh). Trans. Faraday Soc., 62: 70-80(Jan. 1966).

Aliphatic alcohols increase the yields of N_2O observed in the radiolysis of NO solutions and are oxidized to the corresponding aldehyde in the process. The following reactions occur in addition to those previously suggested for the NO radiolysis: $OH + ROH \rightarrow H_2O + \cdot ROH \cdot ROH + 3NO \rightarrow N_2O + HNO_2 + R\cdot = 0$ (aldehyde) where R = Me, Et, i-Pr. Values of the rate constant ratio $k_{(OH+NO)}/k_{(OH+ROH)}$ were obtained from studies of $G(N_2O)$, and for methanol only, from the formaldehyde yields. Measurements of the decrease of $G(CH_2O)$ caused by the addition of a third solute to solutions of NO and methanol are also reported. From these the ratio $k_{(OH+solute)}/k_{(OH+MeOH)}$ was determined for the two solutes bromide ion and nitrite ion. Rate constants for reactions of OH are found to be in the ratio: 0.35 for MeOH, 1.0 for EtOH, 1.0 for i-PrOH, 1.5 for Br^-, 2.2 for NO_2^-, and 4.3 for NO. (auth)

23169 RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS CONTAINING CARBON MONOXIDE AND OXYGEN BETWEEN pH 0.4 AND 12. Balkas, T.; Dainton, F. S.; Dishman, J. K.; Smithies, D. (The University, Leeds, Eng.). Trans. Faraday Soc., 62: 81-7(Jan. 1966).

$G(H_2)$, $G(CO_2)$, $G(H_2O_2)$, $G(-O_2)$ and $G(-CO)$ were measured for x-irradiated aqueous solutions containing CO and O_2 in the pH range 0.4-12. A reaction mechanism is used as a basis for calculation of primary yields. Whereas $G_{H2} = 0.48 \pm 0.05$ and $G_{H_2O_2} = 0.74 \pm 0.09$ are substantially independent of pH, G_{-H_2O} G_{OH} and $(G_{e^-_{aq}} + G_H)$ each diminish by about 0.9 unit as the pH is increased from 1.4 to 2.2, thereafter remaining constant at 3.7 ± 0.2, 2.14 ± 0.04 and 2.8 ± 0.15 respectively. (auth)

23170 KINETICS OF RADIATION-INDUCED CATIONIC POLYMERIZATION. PROPAGATION RATE CONSTANT FOR α-METHYLSTYRENE. Hubmann, E.; Taylor, R. B.; Williams, Ff. (Univ. of Tennessee, Knoxville). Contract AT-(40-1)-2968. Trans. Faraday Soc., 62: 88-96(Jan. 1966).

The radioinduced polymerization of dry α-methylstyrene is found to be strongly retarded by the addition of very low concentrations of ammonia or trimethylamine. From a study of these effects, the predominant contribution to the polymerization is attributed to a cationic propagation mechanism involving free ions. This interpretation is consistent with other lines of evidence. By kinetic analysis, the propagation rate constant k_p at 30°C is estimated to be 3×10^6 M^{-1} sec^{-1}. (auth)

23171 OXIDATION OF URANIUM DIOXIDE BY CARBON DIOXIDE IN A REACTOR FLUX. Dominey, D. A.; Morley, H.; Young, D. A. (Atomic Energy Research Establishment, Harwell, Eng.). Trans. Faraday Soc., 62: 233-47(Jan. 1966).

Exposure of microcrystalline UO_2 to CO_2 in a reactor flux between 40 and 500°C leads to the formation of CO and UO_{2+x}, where x does not exceed 0.25. The UO_{2+x}, a disordered cubic phase which is thermodynamically unstable at low temperatures, is stable to annealing at temperatures below 650°C, but when heated to 750°C recrystallizes into the thermodynamically stable forms U_4O_9 and UO_2. The initial rate of oxidation is proportional to surface area of the UO_2 and independent of CO_2 pressure, the geometry of the system and of inert gas diluents. UO_2 is oxidized by products of radiolysis of chemisorbed CO_2. Active species produced in the gas phase remote from the solid do not take part in the oxidation. A radiation-assisted reduction of UO_{2+x} by CO also occurs, the rate being dependent on temperature. The steady-state composition of UO_{2+x} at a given temperature is controlled by the relative rates of the oxidation by CO_2 and the reduction by CO. High G values for γ-radiolysis of CO_2 in this system arise from direct energy transfer to the gas from the solid surface. (auth)

23172 STUDY OF THE INFLUENCE OF VARIOUS ADDITIVES ON THE POLYMERIZATION OF ACRYLONITRILE IN DIMETHYLFORMAMIDE BY THE ACTION OF GAMMA RAYS. Arifdzhanov, A.; Sultanov, A. S. Uzbek. Khim. Zh., No. 6, 40-4(1964).

The production of highly viscous solutions appropriate for spinning was investigated. Commercial acrylonitrile was treated twice with a 10% alkaline solution, distilled twice, washed with distilled water, dryed over $CaCl_2$, and distilled again. Next, 2-ml portions of acrylonitrile were dissolved in 4 and 5 volumes of dimethylformamide, mixed with 0.5% solutions of ammonium persulfate, hydrogen peroxide, hydroquinone, toluene, pyrogallol, carbon tetrachloride, hexachloroethane, free sulfur, and dimethylformamide solution of acetic acid. Each specimen was sealed in a glass tube and irradiated with γ rays at 30–40°C. Ammonium persulfate gave 99% yields. Azodiisobutyronitrile and n-toulenesulfonic acid gave 100% yields, but the viscosities of the products were insufficient. (CFSTI)

23173 THE EFFECT OF γ-RAY RADIATION IN VACUO ON SEVERAL KINDS OF CONJUGATED COMPOUNDS CONTAINING NITROGEN. Kurabayashi, Yumiko; Kurihara, Katsumi (Tokyo Univ.). Vacuum Chem. (Tokyo), 13: 146-8(Aug. 1965). (In Japanese).

Several kinds of conjugated compounds containing nitrogen, e.g., N,N′-di-(2-acetylvinyl)-m-phenylenediamine(I), N,N′-di-(2-acetylvinyl)-p-phenylenediamine(II), 1,4-diphenyl-3,5-diacetyl-1,4-dihydropyridine(III) and melanin (IV) were found to be stable under γ irradiation in vacuo (total dose 5×10^7 R, dose rate 1.5×10^5 R/hr), except that II showed a little change in uv absorption spectrum and the solubility of IV in dimethylformamide decreased slightly during irradiation. (auth)

23174 X-RAY PHOTOGRAPHIC DETERMINATION OF DEGREE OF CRYSTALLINITY IN RADIATION CHLORINATION AND SULFOCHLORINATION OF POLYETHYLENE. Dzhagatspanyan, R. V.; Sokolov, V. A.; Khromenkov, L. G.; Korolev, B. M. Vysokomol. Soedin., 8: 193-7(Feb. 1966). (In Russian).

Radioinduced chlorination of polyethylene in the solid state and the effects of, chlorine content on crystallinity were studied. The final product of chlorination was apparently amorphous polyvinyl chloride. Polyethylene sulfochlorination lowered the degree of crystallinity in the same way as chlorination. (auth)

23175 STUDY OF RADIATION-INDUCED SOLID-STATE POLYMERIZATION OF TRIOXANE. Urman, Ya. G.; Slonim, I. Ya.; Ermolaev, A. D. (Scientific-Research Inst. of Plastics, USSR). Vysokomol. Soedin., 8: 251-5(Feb. 1966). (In Russian).

The changes in NMR spectra in radioinduced polymerization of trioxine in the solid state were studied. Conversion of trioxane to polyoxymethylene was accompanied by changes in the second moment of the NMR spectrum and depended on the sample orientation in the magnetic field. In the course of the polymerization the accumulation of low molecular products giving narrow component in the NMR spectrum was observed. (auth)

23176 SOME FEATURES OF DI-β-NAPHTHYL-p-PHENYLENEDIAMINE ACTION DURING RADIATION-INDUCED POLYCAPROAMIDE OXIDATION. Fomenko, A. S.; Abramova, T. M.; Dar'eva, E. P.; Galina, A. A.; Furman, E. G. (Pisarzhevskii Inst. of Physical Chemistry, USSR). Vysokomol. Soedin., 8: 261-6(Feb. 1966). (In Russian).

No effects of an antioxidant (di-β-naphthyl-p-phenylenediamine (DNFDA)) on the kinetics of accumulation and on the yield of free radicals from gamma-irradiated polycaproamide were found by ESR techniques. The introduction of 0.5% of DNFDA into the polymer did not affect the kinetics of accumulation or the yields of carbon monoxide and hydrogen, but decreased the amount of carbon monoxide on radioinduced oxidation. DNFDA had less effect on viscosity and the end groups than in the case of unstabilized polymers. The amounts of peroxide, carbonyls, and carboxyl-containing compounds formed on radioinduced polycaproamide oxidation were small. DNFDA decreased the infrared absorption bands at 1550, 3300, 2870, and 2940 cm^{-1} by cleavage of C–H and C–N bonds on radioinduced polycaproamide oxidation. The results verified the possibility of using DNFDA as an antioxidant in photo- and thermo-oxidation and also in radioinduced polyamides oxidation. (auth)

23177 BEHAVIOR OF UNSATURATED FATTY ACIDS AND LIQUID ORGANIC COMPOUNDS IN GAMMA-RAY FIELD. II. EFFECTS OF HIGH DOSE IRRADIATION UNDER ELECTRON-BEAM AND ^{60}Co GAMMA-RAY. Kitahara, Kazuta; Tanaka, Yoshimasa; Inoue, Fukuko (Kumamota Univ., Japan). Yakugaku Zasshi, 85: 902-5 (Oct. 1965). (In Japanese).

Methyl oleate, methyl linoleate, and methyl linolenate were irradiated with 1.8-Mev electrons from a Van de Graaff generator or ^{60}Co γ rays. The dose used with electrons was 2.4×10^8 R and with γ radiation varied from 0.53 to 4.3×10^8. The radiolytic products were analyzed by infrared spectrophotometry and gas chromatography. An increase in the absorption band at 965 cm^{-1} in the infrared spectra of the fatty acid esters indicated the occurrence of cis-trans isomerization. This change was especially marked in methyl linolenate. A mixture of methyl oleate, methyl linoleate, and linolenate, used as internal standard for methyl myristate, was irradiated to ~10^8-R in an oxygen-free state and the products examined by gas chromatography. The decomposition rate constant of these unsaturated fatty acids by γ rays was calculated

for the primary reaction from the results of gas chromatographic analysis and it was found that they underwent decomposition in proportion to the square of the number of double bonds in the molecule. No difference was found in these results between electron and γ radiation. (BBB)

23178 BEHAVIOR OF UNSATURATED FATTY ACIDS AND LIQUID ORGANIC COMPOUNDS IN A GAMMA-RAY FIELD. III. STUDIES ON ELECTRIC CONDUCTIVITY WITH A SPECIAL TYPE OF MEASURING CELL USING LIQUID PARAFFIN. Kitahara, Kazuta; Tanaka, Yoshimasa; Koyano, Akira (Kumamoto Univ., Japan). Yakugaku Zasshi, 86: 42-5(Jan. 1966). (In Japanese).

Radiochemical reaction mechanisms of liquid organic compounds on the basis of their electric conductivity were studied. The effects of voltage and temperature on electric resistance of samples sealed in liquid paraffin were examined by using a special measuring cell having a wide electrode area. It was found that electric resistance increased with increasing voltage during irradiation. Effect of temperature on electric resistance was smaller during irradiation than in the absence of irradiation, and the activation energy calculated from the observed value was about 0.2 ev with irradiation at 1.2×10^5 R/hr as against about 0.7 ev without irradiation. This indicates that activation energy falls at the time of irradiation, as is the case with solid polymers. Dose-rate response was rapid and within the transition rate of the radiation source. The values at re-irradiation reproduced the values corresponding to the irradiation dose. From these results it was concluded that the increase of electric conduction during γ irradiation is due to electrons being liberated. (BBB)

23179 RADIOLYSIS OF AQUEOUS HEXACYANOFERRATE SOLUTIONS. Mohrmann, Hasso; Froben, Friedrich Wilhelm (Univ., Goettingen, Ger.). Z. Phys. Chem. (Frankfurt), 47: 257-66(Dec. 1965). (In German).

The effect of x radiation on the redox system hexacyanoferrate(II)/hexacyanoferrate(III) in acid, neutral, and alkaline solutions was measured continuously during the exposure and is discussed using reaction equations. The measurement installation used made it possible to observe oxidation and reduction on the same sample in acid solution with methanol additions and oxidations in alkaline solutions without additions. It also made it possible to measure an expected effect of the dose output on the yield in alkaline solutions in the presence of N_2O. From the measurement results some quotients of the reaction constants could be determined: $\underline{k}(OH + CH_3OH)/\underline{k}(OH + Fe(CN)_6^{4-}) = 2.7 \times 10^{-3}$ and $\underline{k}(CH_2OH + O_2)/\underline{k}(CH_2OH + Fe(CN)_6^{3-}) = 1$ at pH = 0.4; $\underline{k}(e^- + Fe(CN)_6^{3-}) = 1.2 \times 10^{-3}$ and $\underline{k}(CH_2OH + O_2)/\underline{k}(CH_2OH + Fe(CN)_6^{3-}) = 5.7 \times 10^{-2}$ at pH = 7; and $\underline{k}(e^- + O_2)/\underline{k}(e^- + Fe(CN)_6^{3-}) = 1$ at pH = 14. (tr-auth)

23180 KINETIC STUDIES ON THE RADIATION-CHEMISTRY CARBOXYLATION OF METHANOL. Guetlbauer, F.; Getoff, N. (Institut fuer Radiumforschung und Kernphysik, Vienna). Z. Phys. Chem. (Frankfurt), 47: 299-305(Dec. 1965). (In German).

From experimental data on the carboxylation of methanol to glycolic acid by means of ^{60}Co γ radiation, some reaction velocity constants were calculated. These are: $k_{CH_3OH+OH} = 3 \times 10^8$ mol^{-1} × sec^{-1}, $k_{CH_2OH+CO_2^-} = 5 \times 10^8$ mol^{-1} × sec^{-1}, and $k_{CO_2+H} < 8 \times 10^6$ mol^{-1} × sec^{-1}. (tr-auth)

23181 CHEMICAL EFFECTS OF THE TRANSFORMATION $^{82m}Br \xrightarrow{IT} {}^{82}Br$ IN VARIOUS LIQUID AROMATIC COMPOUNDS. Stamouli, Maria I.; Katsanos, Nicholas A. (Nuclear Research Center Democritus, Athens). Z. Phys. Chem. (Frankfurt), 47: 306-12(Dec. 1965).

Chemical effects of the isomeric transition $^{82m}Br \rightarrow {}^{82}Br$ were studied in benzene, fluorobenzene, chlorobenzene, bromobenzene, iodobenzene, and nitrobenzene, at various molecular bromine concentrations. In the halobenzenes a large fraction of the organic retention resulted from displacement of the halogen atom by ^{82}Br and the higher this fraction the smaller the strength of the carbon-halogen bond. Retention values also depended on the amount of Br_2 present; they were lower at higher mole fraction of Br_2. The results were consistent with the hypothesis that organic retention, especially in the form of $C_6H_5\ ^{82}Br$, is mainly due to reactions of thermalized radiobromine ions in an unusual reduced state with the molecules of the surrounding medium. (auth)

23182 PHOTOPRODUCTION OF RADICALS IN γ-IRRADIATED FROZEN ACETONE. Pukhal'skaya, G. V.; Kotov, A. G.; Pshezhetskii, S. Ya. Zh. Fiz. Khim., 40: 714-18(Mar. 1966). (In Russian).

The character of radical formation during γ radiolysis and photolysis of acetone differed: under γ irradiation the radical CH_3COCH_2 was formed principally, whereas under the effects of uv irradiation the radicals CH_3CO and CH_3 were formed. The photodecay of acetonyl radicals with the formation of CH_3 proceeded considerably faster than the decay of acetone molecules. The curves of the dependence with (Λ) for the radical CH_3COCH_2 agreed with the absorption spectra of acetone. During photolysis of acetonyl radicals as a result of secondary reaction the radical CH_3CO can be formed. (tr-auth)

23183 IRRADIATION OF ION EXCHANGE RESINS BY A HORIZONTAL BEAM OF ACCELERATED ELECTRONS. Tulupov, P. E.; Greben, V. P.; Bychkov, N. V.; Kasperovich, A. I. (Karpov Inst. of Physics and Chemistry, USSR). Zh. Fiz. Khim., 40: 748-50(Mar. 1966). (In Russian).

A method for the exposure of ion exchange resins with horizontal beams of accelerated electrons is described. In the method the intensity of the electron beam current was recorded. Dosimetry with Cu–Fe sulfate showed that the intensity of the dose is directly proportional to the intensity of the electron beam current. Satisfactory reducibility of the results was obtained in the radiation of the cationite KU-2. The deviation of the loss of exchange capacity of the cationite did not exceed 3% in parallel tests. (tr-auth)

23184 EFFECTS OF LOW ENERGY PROTONS ON THERMAL CONTROL COATINGS. Miller, R. A.; Campbell, F. J. (Naval Research Lab., Washington, D. C.). New York, American Inst. of Aeronautics and Astronautics, 1965, Preprint No. AIAA 65-648, 12p., $1.00. (CONF-650955-3). ORINS.

From American Inst. of Aeronautics and Astronautics, Thermophysics Specialist Conference, Monterey, Calif.

A series of thermal control paints consisting of several pigments and binders were irradiated with protons at four specific energies between 50 and 400 kev. This study was made because of the presence of high fluxes of protons with energies below 1 Mev in the outer radiation belt and in solar flare events. In this range, the entire energy exchange occurred within the paint film so that all incident energy was absorbed. The resulting damage was observed as a decrease in spectral reflectance. The amount of degradation, calculated in the 0.400 to 0.433 micron region for each material, was found to be nearly linear with absorbed energy, a product of the kinetic energy of the protons times their total integrated flux. An evaluation of the data in terms of solar absorption indicated that equal numbers of protons of a higher energy produce a greater change in solar absorption than protons of a lower energy. In the range of fluxes investigated (from 1×10^{10} to 1×10^{12} protons/cm^2/sec), the damage was found to be nearly independent of flux indicating the possibility of extrapolating the results to fluxes encountered in space. (auth)

23185 CONTRIBUTION TO A STUDY OF STRUCTURE IMPERFECTIONS IN LITHIUM FLUORIDE AND α-QUARTZ IRRADIATED BY NEUTRONS. Comes, Robert (Univ. Paris, Orsay, France). 83p. (In French). (CONF-650660-1). ORINS. Gmelin, AED-CONF-65-154-1.

From American Crystallographic Association and Mineralogical Society of America Joint Meeting, Gatlinburg, Tenn.

The faults caused by neutron irradiation were studied in two completely different types of substances. Lithium fluoride furnishes an example of an irradiated ion crystal and quartz is an example of a crystal with a completely covalent character. The results obtained together with those from previous works made it possible to draw some general conclusions on faults introduced by irradiation in these two

types of crystals. Ionic crystals are a result of an electrostatic equilibrium and there is only a single structure for a given ionic crystal. Under these conditions neutron irradiation destroys not only the structure but the substance itself. In the irradiated LiF crystal there is an appearance of metallic lithium, the loss of fluoride, and in the final stages the appearance of oxides. In the case of quartz, there is a rigid element in the structure of the tetrahedrons. A flexible bond connects the tetrahedrons by the intermediary of an oxygen atom. Irradiation destroys the structure, but the substance itself is preserved. This is the origin of the many known phases of SiO_2. (tr-auth)

23186 METHOD FOR PRODUCING A LUMINESCENT MATERIAL BY IRRADIATION. Oya, Shinzo (to Teijin Ltd.). Japanese Patent 1963-28624. Dec. 10, 1964. Filed Sept. 25, 1961.

A new method is proposed for producing a luminescent material by irradiating sodium silicate monohydride, sodium selenate, sodium phosphate, lithium carbonate, or potassium sulfate with an ionizing radiation in the presence of air, in an inert gas, or in a vacuum at temperatures from 4 to 243°K. (NSA of Japan)

23187 METHOD FOR GRAFT COPOLYMERIZATION ONTO POLYVINYL ALCOHOL BY PREIRRADIATION. Tashiro, Shigeki (to Japanese Association for Radiation Research on Polymers). Japanese Patent 1964-9970. May 21, 1965. Filed Jan. 20, 1962.

A new method for graft-copolymerizing by preirradiation vinyl monomers onto polyvinyl alcohol is proposed that can be carried out in the presence of air with a high efficiency. The polyvinyl alcohol to be grafted is irradiated in the presence of air either before or after it is dipped in and impregnated with an aqueous or organic solution of a peroxides such as H_2O_2 or $K_2S_2O_8$. Then the impregnated polyvinyl alcohol is dipped in a solution of radical-polymerizable monomer, the solvent of which is a mixture of organic solvent and water containing ferrous salt at a concentration from 1×10^{-2} to 1×10^{-5} mole/l, and heated to a temperature between 30 and 80°C in the presence of air. (TCO)

23188 METHOD FOR PRODUCING POLYSULFONE RESINS. Tashiro, Shigeki (to Japanese Association for Radiation Research on Polymers). Japanese Patent 1964-9971. May 21, 1965. Filed Apr. 2, 1962.

A new method for producing polysulfone resins is characterized in that a mixture of sulfur dioxide with vinyl acetate and/or other vinyl monomer such as styrene, acrylamide, or methyl acrylate is irradiated at a temperature from −10 to −200°C. The polymeric polysulfone resins produced are white powders after stripping off the unreacted sulfur dioxide at a reduced pressure. The softening points of the polymers are over 200°C, and they are soluble in dimethyl sulfoxide but insoluble in acetone, benzene, alcohol, etc. The copolymers, in general, dissolve and decompose in an aqueous alkaline solution, but the copolymer with styrene is insoluble and stable in an aqueous alkaline solution. (NSA of Japan)

23189 METHOD FOR RADIATION-POLYMERIZING CONJUGATED DIOLEFINS. Ohara, Soichiro (to Kurashiki Rayon Co., Ltd.). Japanese Patent 1964-9974. May 21, 1965. Filed Dec. 20, 1961.

In a proposed method for radiation-polymerizing conjugated diolefins, the monomers are irradiated in the presence of halogen or oxyhalogen compounds of IV-b and V-b group elements of the periodical table to produce the polymers predominantly of the 1,4-addition type polymeric structure. (NSA of Japan)

23190 METHOD FOR PRODUCING GRAFT COPOLYMERS. Hara, Kichihei (to Dainippon Spinning Co., Ltd.). Japanese Patent 1964-15658. July 21, 1965. Filed Dec. 30, 1961.

A new method for producing graft copolymers by polymerization reactions in the presence of metal salts is proposed. Organic polymers or their derivatives, containing carbon atoms in their main or side chains, are irradiated in an atmosphere of air or oxygen with an ionizing radiation at total doses of more than 5×10^4 R. Then the irradiated polymers are brought into contact with the monomers polymerizable by the free radical mechanism in the presence of trivalent titanium salts which give polymerization activity to the graft copolymerization reactions. (TCO)

23191 METHOD FOR POLYMERIZING VINYL ESTERS. Ohara, Soichiro (to Kurashiki Rayon Co., Ltd.). Japanese Patent 1964-15826. July 22, 1965. Filed Aug. 7, 1962.

A new method for polymerizing vinyl esters, such as vinyl acetate, consists of irradiating the ester with an ionizing radiation in the presence of zinc chloride admixed and in a frozen solid state. (NSA of Japan)

23192 METHOD FOR POLYMERIZING VINYL ESTERS. Ohara, Soichiro (to Kurashiki Rayon Co., Ltd.). Japanese Patent 1964-15827. July 22, 1965. Filed Aug. 7, 1962.

The polymerization of vinyl esters is achieved very rapidly by irradiating admixtures with zinc chloride with an ionizing radiation in the liquid state at a temperature below −20°C. (NSA of Japan)

23193 METHOD FOR PRODUCING TRIOXANE COPOLYMERS. Miyazaki, Kagayaki (to Asahi Chemical Industrial Co., Ltd.). Japanese Patent 1964-15835. July 22, 1965. Filed Aug. 24, 1962.

The irradiation of trioxane in the presence of styrene or its homologous compounds yields copolymers having especially good whiteness and high thermal stability. (TCO)

23194 METHOD FOR POLYMERIZING TRITHIANE WITH AN IONIZING RADIATION. Miyazaki, Kagayski (to Asahi Chemical Industrial Co., Ltd.). Japanese Patent 1964-16152. July 26, 1965. Filed Dec. 14, 1962.

A new method is proposed for polymerizing trithiane (1,3,5-trimethylene sulfide) with an ionizing radiation in the temperature range from 100° to 250°C. The product has structural units of methylene sulfide or methylene thioacetal. (TCO)

Radiochemistry

See *also* Separation Processes and Procedures

Refer also to abstracts 23236, 23544, and 24299.

23195 (BNL–10033) LABELING OF ORGANIC COMPOUNDS BY IRRADIATION AND OTHER NON-SYNTHETIC METHODS. Wolf, Alfred P. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT-30-2-GEN-16. 44p. (CONF-660602-1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From 2nd International Conference on Methods of Preparing and Storing Labelled Molecules, Brussels.

The labeling of organic compounds by various methods, such as nonchemical synthesis, radiation, excitation, recoils, accelerated ions, and miscellaneous methods, is reviewed. Both practical and theoretical aspects of the labeling processes are considered, along with the benefits and limitations of each method. (153 references). (P.C.H.)

23196 (CEA-R–2989) SYNTHESE DE LA DL-METHIONINE CARBOXYLE ^{14}C ET SA RESOLUTION ENZYMATIQUE EN L-METHIONINE CARBOXYLE ^{14}C. (Synthesis of DL-Methionine Carboxyl ^{14}C and its Enzymatic Optical Resolution into L-Methionine Carboxyl ^{14}C). Guermont, Jean-Pierre; Sharefkin, David; Pichat, Louis (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1966. 12p. Dep. mn.

DL-methionine-1-^{14}C was prepared by the Strecker reaction from ^{14}C N K and β-methylmercaptopropionaldehyde with a 61% yield. The enzymatic resolution of N-acetyl DL-methionine gives rise to L-methionine-1-^{14}C with a 78% yield. (auth)

23197 PRODUCTION OF HIGH SPECIFIC ACTIVITY ^{51}Cr BY NEUTRON IRRADIATION OF POTASSIUM CHROMATE. Kozomara, S.; Milenkovic, S.; Dizdar, Z. Bull. Boris Kidrich Inst. Nucl. Sci., 16: 245-50 (Oct. 1965).

The method of Douis and Valade for obtaining high-

specific-activity ^{51}Cr was modified by oxidizing trivalent chromium with hydrogen peroxide without using alkali. In this way the presence of silicon in the final product was avoided, which is important in applying radioactive chromium in medicine. (auth)

23198 RADIOISOTOPES IN CHEMICAL RESEARCH. Martin, G. R. (Univ. of Canterbury, Eng.). Chem. Ind. (London), No. 31, 1361-3(July 31, 1965).

Some aspects of the use of radioisotopes in chemistry are reviewed. Errors can be introduced by even small amounts of radioactive material present in a wrong (nonexchanging) and unsuspected chemical form, especially if carrier is subsequently to be added only for the main radioactive constituent. Trouble of this sort can arise in labeled organic compounds from self-radiolysis. Even when gross chemical differences are eliminated, isotopic substances are not quite identical since, as shown by absolute reaction rate theories, velocities of reaction are influenced by the reduced mass of the reacting system. If tritium is used as a tracer for hydrogen the threefold difference in mass can give rise to an even larger factor in the rate of reaction. For ^{14}C used as a tracer for ^{12}C, errors of 10% or more in reaction rate estimates can occur. The problem becomes progressively less serious in going to heavier elements, and soon becomes insignificant in comparison with other sources of error. For reactions where plausible assumptions can be made about the natures of possible transition states, the magnitude of the isotope effect for the various mechanisms can often be estimated by application of the procedures of absolute rate theory and a comparison with experiment enables a decision to be taken between the various alternative mechanisms. An isotope effect appears as a systematic variation in the product's specific activity as a function of the degree of completion of the reaction. Use of the Mössbauer effect in chemistry is also considered. (BBB)

23199 ENZYME PREPARATION OF ^{35}S HYPOTAURINE. Mosti, R.; De Maria, V.; De Marco, C. (Univ., Rome). Ital. J. Biochem., 14: 107-10(Mar.-Apr. 1965).

A method for obtaining ^{35}S-hypotaurine in a high state of purity that may be used for preparative purposes is described in detail. The reaction used is that catalyzed by an enzymic system present in horse kidney and is one capable of oxidizing cysteamine in the presence of sulfide to hypotaurine and thiotaurine. A method for separating ^{35}S-hypotaurine is outlined. Specific activity of the ^{35}S-hypotaurine was dependent on the radioactivity of the ^{35}S-cysteamine used as substrate and on the quantity of hypotaurine added as carrier during chromatographic separation. (TCO)

23200 OXIDATION STATES OF ^{131}I AFTER NEUTRON IRRADIATION OF CRYSTALLIZED TeO_2 AND DISSOLUTION IN ALKALINE MEDIA. Ortega, J. (Ciudad Univ., Madrid). J. Inorg. Nucl. Chem., 28: 668-70(Feb. 1966). (In French).

In the preparation of carrier-free ^{131}I by neutron irradiation of TeO_2, it was found that the percentages of reduced form of ^{131}I, when the irradiated TeO_2 is dissolved in 2 M NaOH, vary as a function of the length of radiation. The cause of this variation and the percentage of reduced form were investigated. It was found that γ radiation has a remarkable effect on the percentage of reduced form produced. It was assumed that the changes of the reduced form are caused by the γ effects of the marco constituents of the irradiated solid. The possibility of reducing the iodate form to the iodide form by the addition of elementary Te is shown. It was also found that the order of addition of the reagents (TeO_2 and KIO_3) into the NaOH solution affects the relative distribution of the oxidation states. (J.S.R.)

23201 THE USE OF ^{36}Cl IN POLYMER CHEMISTRY. Bevington, J. C.; Johnson, M. (Univ. of Lancaster, Eng.). Makromol. Chem., 87: 66-72(1965).

A comparison is given of methods for the assay of ^{36}Cl, and a study of the radical copolymerization of methyl methacrylate (MMA) and methyl α-chloroacrylate (MCA) is described. In the copolymerization, product analyses obtained using ^{14}C-MMA were compared with those obtained using ^{36}Cl-labeled samples of the other monomer; it was thus possible to assess the general validity of results obtained using ^{36}Cl as a tracer. ^{36}Cl has a long life, is a pure β emitter with E_{max} equal to 0.72 Mev, and is comparatively nonhazardous. E_{max} for ^{36}Cl is such that the isotope can be assayed by using either an end-window counter or a liquid sleeve counter, but the efficiencies are low, about 5 and 1%, respectively. The results of scintillation counting for copolymers of ^{14}C-MMA and cyclohexyl methacrylate are shown. A comparison was made of the compositions of the copolymers derived from the results of scintillation counting, and those of gas counting. There was good agreement between the two sets of results. For scintillation counting, the efficiency of detection was about 30%. Results for scintillation counting of copolymers of MMA and ^{36}Cl-MCA again showed that the significance of quenching depends on the composition of the copolymer. The phenomenon is less significant than for ^{14}C because E_{max} for ^{36}Cl is considerably larger. The efficiency for ^{36}Cl under the specified conditions was about 60%. When the results obtained from the ^{14}C and ^{36}Cl experiments for copolymers of MMA and MCA were compared, there was good agreement. It was concluded that scintillation counting in solution can be used successfully in connection with tracer experiments in polymer chemistry. (BBB)

23202 SEPARATION OF ^{140}La FROM A ^{140}Ba–^{140}La MIXTURE BY COPRECIPITATION WITH FERRIC HYDROXIDE, USING SEVERAL ORGANIC BASES AS PRECIPITANTS. Koda, Yoshio (Government Industrial Research Inst., Nagoya, Japan); Takagi, Shigemichi. Rep. Gov. Ind. Res. Inst., Nagoya, 14: 377-83(Oct. 1965). (In Japanese).

Ammonia water was utilized for the separation of ^{140}La from a mixture of $^{140}Ba-^{140}La$ by the standard method of coprecipitation with ferric hydroxide. Almost all ^{140}Ba in the case without carriers, and about 7% of ^{140}Ba in the case with carriers, was coprecipitated with ferric hydroxide. To separate pure ^{140}La from a $^{140}Ba-^{140}La$ mixture, several organic bases such as pyridine, α-picoline, benzylamine, n-butylamine, and ethylenediamine were used as precipitants. By using these organic bases, it was easy to maintain the pH value of a test solution within a narrow range. When pyridine was used, only 0.04 ~ 0.2% of ^{140}Ba was coprecipitated without carrier. When α-picoline was used, only 0.1 ~ 0.8% of ^{140}Ba was coprecipitated. When benzylamine was used, the purity of ^{140}La was nearly the same as that achieved by using ammonia water. The degree of contamination of ^{140}Ba is inversely proportional to the pK value of the precipitants. A similar result was obtained in the case of $^{90}Sr-^{90}Y$, although the purity of ^{140}La is lower than that of ^{90}Y. (auth)

23203 ON THE BIOSYNTHESIS OF THE TERPENE MARRUBIIN FROM 1,4-^{14}C-SUCCINIC ACID AND 2-^{14}C-MEVALOLACTONE. Abbondanza, Ada; Badiello, Roberto; Breccia, Alberto (Univ., Bologna). Tetrahedron Lett., No. 48, 4337-41(Dec. 1965).

The terpene marrubiin labeled with ^{14}C was prepared by supplying flowering plants of Marrubium vulgare the ^{14}C-labeled substrates acetate, succinic acid, and mevalolactone. The flowering plants were cut at the base of the stem at root level and 500 g of fresh tissue was grown in 50 ml radioactive solution and 50 ml distilled water added every 10 hr. After a given period, the marrubiin was extracted from the dried plants. The kinetics of incorporation of 1,4-^{14}C-succinic acid into marrubiin was correlated with the kinetics of other precursors in an evaluation of the intermediate steps in marrubiin biogenesis. Degradation of the marrubiin, labeled from 2-^{14}C-mevalolactone and from 1,4-^{14}C-succinic acid, yielded a ketolactone with a sp act. of 70% and 68%, respectively, referred to the terpene. On the basis of a molecular structure, regarding marrubiin as a diterpene, it must contain four isoprenic units. The radioactivity data on the incorporation of 1,4-^{14}C-succinic acid and 2,3-^{3}H-succinic acid suggest that at least three carbon atoms of each succinic acid unit are involved in the marrubiin biogenesis. Both labeled compounds are incorporated. It is suggested that the pathway of incorporation of 1,4-^{14}C-succinic acid into marrubiin via isoprenic units

may involve only one $-^{14}COOH$ of the acid for each isoprenic unit. In such a way, four ^{14}C could be incorporated into marrubiin and three ^{14}C in the ketolactone, 75% of the total incorporated radioactivity. The remaining activity in the ketolactone is 68%, in good agreement with the above data. (BBB)

23204 LABELING OF FIBRINOGEN BY A METHOD USING CHLORAMINE T. Reuge, Cl. (Centre National de Tranfusion Sanguine, Paris). Transfusion (Paris), 8: 73-5(1965). (In French).

Fibrinogen containing 85% coagulable proteins dissolved in 5% trisodium citrate was mixed with 0.01N KI in a ratio to yield one I per fibrinogen molecule, ^{131}I as NaI (C.E.A. solution S3), chloramine in citrate (0.01 times the weight of fibrinogen). After one minute the reaction was quenched with Na metabisulfite (0.02 times the weight of bisulfite). The labeled protein was passed over Amberlite 400 IRA and dialyzed for 6 hr against a hypertonic solution of NaCl (15.5 g/l) and Na citrate (4.7 g/l) at pH 6.3. The solution was filtered and could be preserved several days after freezing; the hypertonic solution was maintained through congelation and decongelation. Coagulation by thrombin gave the same % coagulable proteins as before treatment, electrophoretic behavior was the same, and free I calculated by trichloroacetate precipitation was 1%. Reproducible results were obtained. A solution containing 10 mg/ml coagulable protein had mean act. of 75 μC/ml in practice. (BBB)

23205 PREPARATION OF FAT LABELED WITH RADIOIODINE. Liao, Shih-hsuan; Hsu, Te-yu. Yuan tzu Neng, No, 4, 349-51(1965).

Fats labeled with ^{131}I suitable for clinical application are usually prepared by the use of elemental ^{131}I, ^{131}ICl, or ^{131}IF to react with the unsaturated bonds of the fats. The radioactivity yields of the labeled products prepared from three different kinds of pure vegetable oil (sesame seed, peanut, and soybean oils) as well as triglycerides were determined. The effects of the amount of $K^{131}I$ used and the length of reaction time on the radioactivity yields of these products were also studied. A specially designed apparatus for the continuous preparation of ^{131}I-labeled fat and for the protection of the worker from radiation hazards is also described. Under prescribed conditions (2 ml oil, 10 mg $K^{131}I$, 1 hr reaction time), the radioactivity yields for both sesame seed oil and peanut oil were found similar to that of triglyceride. The yield of soybean oil was slightly higher. The most suitable amount of $K^{131}I$ to be used is given as 10 mg per 2 ml of oil. When less than this amount of $K^{131}I$ was used, the radioactivity yield of the fat was reduced. Excess amounts of $K^{131}I$ did not improve the yield to any significant degree. Prolonging the reaction time from 1 to 15 hr slightly increased the radioactivity yield of the product. Both the labeled fats prepared from sesame seed oil and peanut oil were clinically tested, and the results were found equal to that of triglyceride. Sesame oil was especially favored by the patients for its pleasing taste. (ATD)

23206 SBORNIK REFERATU III. CELOSTATNI RADIOCHEMICKE KONFERENCE, LIBLICE 28.IX.-1.X. 1964. Third All Union Conference on Radiochemistry, September 28–October 1, 1964, Liblice, Czechoslovakia. [Rez] Ustav Jaderneho Vyzkumu Ceskoslovenska Akademie Ved, [1965]. 178p. (In Czech). (CONF-640927(Vol.1)).

The 50 papers or abstracts of the papers presented at the Third All-Union Conference on Radiochemistry are compiled. Individual abstracts were prepared for 15 of the papers. Seven papers were previously abstracted for NSA. For abstract numbers of individual papers see CONF-640927 in the Report Number Index. (M.C.G.)

For abstracts of individual papers see: 22925–22930, 23007–23009, 23164, and 23207–23211.

23207 THE APPLICATION OF ELECTROPHORESIS IN RADIOCHEMISTRY. Konrad-Jakovac, Z. (Inst. Ruder Boskovic, Zagreb). pp 74-103 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.1]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965].

Electrophoresis in radiochemistry is reviewed. The mixtures separated, electrolytes used, and techniques are tabulated. The tabulations include separation of natural radioactive isotopes, separation of fission products, separation of rare earths and actinide elements, separation of radioactive daughter products from their parents, tracer level separations of cyclotron components, purification of some radioisotopes, separation of various chemical species produced by recoil processes, and some other separations. (71 references). (J.S.R.)

23208 METHODS AND PREPARATION AND APPLICATION OF RADIONUCLIDE STANDARDS. Bucina, Ivan (UVVVR, Prague). pp 156-73 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.1]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965]. (In Czech).

A survey was made of standards available at the Institute for Research, Production, and Application of Radioisotopes and of methods for their preparation, measurement, and application. Radium standards in solid form and in solutions were prepared. Measurements were made with a spherical 4π ionization chamber with a Townsend compensation circuit. In the ionization chamber the influence of positional dependence was eliminated by a 5-mm Pb filter. Absolute measurements on standard solutions were made with a 4π proportional counter using β-γ and α-γ coincidence methods. Accuracy and correctness were checked by international comparisons. For measurement of ^{14}C and ^{3}H by the liquid scintillation method, combustion methods, and windowless counter methods, special types of standards were designed. Absolute measurement of ^{14}C was made by compensated internal proportional counters. For contamination measurements in water, air, and surfaces, surface standards with the radioactive material contained in a lacquer layer with a weight of less than 1 mg/cm^2 were prepared. Gamma standards, standards for γ spectrometry, and metal standards for α and β radiation are available in the form of sealed standards. (auth)

23209 SBORNIK REFERATU III. CELOSTATNI RADIOCHEMICKE KONFERENCE, LIBLICE 28.IX.-1.X. 1964. Third All Union Conference on Radiochemistry, September 28–October 1, 1964, Liblice, Czechoslovakia. [Rez] Ustav Jaderneho Vyzkumu Ceskoslovenska Akademie Ved, [1965]. 202p. (In Czech). (CONF-640927(Vol.2)).

23210 COPRECIPITATION METHOD FOR THE SEPARATION OF CARRIER-FREE ^{18}F. Berei, K.; Nad, G. (Tsentral'nyi Institut Fizicheskikh Issledovanii, Budapest). pp 174-84 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.2]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965]. (In Russian).

A method for carrier-free production of ^{18}F is reported. The method uses simple equipment and has a good yield and reproducibility. Targets of lithium carbonate in quartz ampoules were exposed to neutron irradiation. The target was dissolved in nitric acid and the ^{18}F coprecipitated with calcium hydroxide by addition of calcium chloride and sodium hydroxide to the solution. After filtration and washing of the solution with concentrated sulfuric acid, the ^{18}F was distilled in the form of HF. The apparatus is shown schematically. The decay curve and the γ spectra of the ^{18}F obtained are given. (J.S.R.)

23211 SOME RADIOCHEMICAL ASPECTS OF RADIONUCLIDES MEASUREMENTS. Jasanovsky, Pavel (UVVVR, Prague). pp 185-207 of Sbornik Referatu III. Celostatni Radiochemicke Konference. [Vol.2]. [Rez] Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved [1965]. (In Czech).

A method for the evaluation of solution absorption inside capillary tubes is reported. The liquid film is removed by centrifugation before it is measured. The equilibrium values of Sr and Y absorption on glass and polyethylene is given. It is shown that in the absorption determination methods a substantial error occurs when rinsing is used to remove the liquid film and droplets from the absorbant surface. The volatility of some elements from residues used to prepare samples for radionuclide measurements is reported. Some methods for self-absorption determination

are given. These include: source preparation methods when self-absorption can be neglected, ^{147}Pm absorption from aqueous solutions on the measuring supports, deposition of solid particles of $BaSO_4$, and reaction of aqueous solutions of H_2SO_4 and a support covered with evaporated Ba. The experimental techniques in the ^{90}Sr self-absorption method using the different energy of mother and daughter radioisotopes are described. This technique is also applicable to other radioisotopes decaying in short decay series. The self-absorption in the evaporation method for preparation of $^{90}Sr + {}^{90}Y$ at different carrier concentration is given. (auth)

Separation Processes and Procedures

See also Analytical Procedures
ISOTOPE TECHNOLOGY — Separation and Production

Refer also to abstracts 24351 and 24670.

23212 (AERE-R-3420) γ RADIATION INITIATED EMULSION POLYMERISATION. Acres, G. J. K.; Dalton, F. L. (Atomic Energy Research Establishment, Harwell (England)). July 1960. 20p. Dep. mn.

The effects of the radiation intensity, dose, and initial monomer concentration on the polymerization rate of styrene and methyl methacrylate emulsions were investigated. The results are discussed with particular reference to the Smith Ewart Theory of emulsion polymerization. (auth)

23213 (CEA-R-2937) COUTS D'INVESTISSEMENT ET D'EXPLOITATION DES USINES DE RETRAITEMENT DE L'URANIUM NATUREL IRRADIE. (Capital and Operating Costs of Irradiated Natural Uranium Reprocessing Plants). Thiriet, Lucien; Jouannaud, Claude; Couture, Jacques; Duboz, Jacques (Commissariat a l'Energie Atomique, Paris (France)); Oger, Claude (Societe Saint-Gobain Nucleaire, Courbevoie (France)). Jan. 1966. 31p. Dep. mn.

A method for analyzing investment and operating costs of natural uranium fuel reprocessing plant (analyzed according to their economic type) is reported. The method helps to establish standard cost structures for the plants, thus allowing comparisons between existing or planned industrial facilities. It also helps to evaluate the foreseeable consequences of technical progress. Some results obtained are given, concerning: the investment costs sensitivity to the various technical parameters defining the fuel and their comparison with the country or economic area taken into account. (auth)

23214 (CEA-R-2946) ETUDE DE LA SOLUBILITE DU NITRATE DE PLUTONYLE EN VUE DE SON EXTRACTION PAR SOLVANT. (Study of the Solubility of Plutonyl Nitrate with a View to its Solvent Extraction). Vergnaud, Gerard (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar. 1966. 83p. Dep. mn.

The partition coefficient of plutonyl nitrate and application to the industrial treatment of plutonium was determined. The solvent used is a tri-n-butyl phosphate solution diluted to 30% in dodecane. The parameters studied that can affect the extraction of the plutonyl nitrate are: plutonyl nitrate concentration, nitric acid concentration, uranyl nitrate concentration, and tetravalent plutonium nitrate concentration. The industrial application was studied using a battery of mixer-separators. The operational conditions are defined in the case of a conventional plutonium separation plant. The results obtained, for a higher plutonyl nitrate concentration than that actually planned, were satisfactory and encouraging as far as the operation is concerned. Only the presence of polymerized tetravalent plutonium can adversely affect the satisfactory extraction of the plutonium. (auth)

23215 (RL-SEP-673) CHLORINATION REACTIVITY OF PLUTONIUM OXIDE PREPARED IN A SCREW CALCINER. Fullam, H. T.; Soine, T. S. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Aug. 13, 1965. Contract AT(45-1)-1350. 22p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The direct calcination of plutonium nitrate solution in a titanium screw calciner was studied. A special batch chlorinator was developed to evaluate the reactivity of the oxide produced in the calciner. It was found that a satisfactory oxide could be produced by direct calcination. The oxide product showed little impurity pickup across the calciner. By use of an activating agent, the oxide could be chlorinated to better than 95 percent under optimum calciner and chlorinator operation. The chloride produced was successfully reduced to metal by electrowinning. A comparison of reactivity of the optimum direct calcined oxide with oxide produced from plutonium oxalate showed that the two were equal. (auth)

23216 (UCRL-16580, pp 213-17) INORGANIC CHEMISTRY. (Lawrence Radiation Lab., Univ. of California, Berkeley).

Research on aromatic diluents for $HClO_4$ extraction by tridodecylamine is described along with spectrophotometric methods for determination of Au using azides. (J.R.D.)

23217 (UCRL-16580, pp 251-4) CHEMICAL ENGINEERING. (Lawrence Radiation Lab., Univ. of California, Berkeley).

Investigation of bacterial sulfate reduction kinetics is reported, and experiments on interphase mass and heat transfer in laminar flow are described. (J.R.D.)

23218 PROPERTIES OF NEW ALIPHATIC AMINES OF HIGH MOLECULAR WEIGHT IN THE EXTRACTION OF URANIUM. Varona, D. Jose Luis Lopez (Universidad de Valladolid, Spain). Afinidad, 22: 5-15(Jan.-Feb. 1965). (In Spanish).

Eight amines were prepared: di-n-nonylamine, tri-n-nonylamine, di-(3-ethylheptyl)amine, tri-(3-ethylheptyl)-amine, di-(3,7-dimethyloctyl)amine, tri-(3,7-dimethyloctyl)-amine, di-(2-methylundecyl)amine, and tri-(2-methyl-undecyl)amine. The solubility of these in kerosene is high; there are moderate losses from kerosene solution for the secondary amines and very little for tertiary amines on extraction of 0.1M solutions (100 ml) with 100 liters of 1.2M H_2SO_4. Data for the nonylamines are graphed. These amines extract $(UO_2)SO_4^{-2}$ from aqueous solutions. The extraction isotherms were determined at pH 1.5. Sulfate, phosphate, and particularly nitrate ions interfere with the extraction. The extraction coefficient varies linearly with the amine concentration. The effect of pH on the extraction coefficient (between 0.3 and 3.2) is marked; results for four amines are tabulated. A flow diagram is given; results of its use on a 1.5-g mineral sample after sulfuric acid attack are tabulated for three tertiary amines as ppm of common impurities by the spectrographic method. (BBB)

23219 CONSTRUCTION OF THE DISSOLVER FOR THE EUROCHEMIC REPROCESSING INSTALLATION. Dreissigacker, H. (Europaeische Gesellschaft fuer Chemische Aufarbeitung Bestrahlter Kernbrennstoffe, Mol, Belg.); Fichtner, H.; Reinartz, W. Atomwirtschaft, 11: 170-3(Apr. 1966). (In German).

Eurochemic has constructed a reprocessing installation in Mol for the treatment of fuel element types with varying combinations of cladding materials and fuel materials. The dissolver of the reprocessing installation is described with respect to its construction, construction materials, and finishing. Specifications of the dissolver are tabulated. (J.S.R.)

23220 SOME EXPERIENCES FROM PILOT PLANT PROCESSING OF MONAZITE SANDS TO RARE EARTH SALTS IN CSSR. Holub, Ludek. Chem. Prumysl, 15: 577-81(1965). (In Czech).

A method for complex processing of Korean and Chinese monazite sands was tried on a pilot plant scale. The monazite sand was enriched by electromagnetic separation and then decomposed by alkali yielding mixed chlorides of rare earth elements, crystalline trisodium phosphate, and thorium oxalate. The mixed rare earth chloride was used as a raw material in electrolysis yielding mixed rare earth

metal; the electrolytic waste was either processed to mixed rare earth oxide suitable as grinding and polishing material for optical glass or used for the production of cerium oxide. (auth)

23221 CHROMATOGRAPHIC SEPARATION OF RARE EARTH ELEMENTS. II. HDEHP–$H_2C_2O_4$ SYSTEM. P'ang, Shu-wei; Liang, Shu-ch'uan. Hua Hsueh Hsueh Pao, 30: 237-40(1964).

The use of reversed phase chromatography for separating several rare earth elements, uranium and thorium using filter paper treated with bis(2-ethylhexyl) orthophosphate in toluene solution as stationary phase and oxalic acid of various concentrations as mobile phase is described. When 0.5 M oxalic acid solution is used, the partition coefficient for uranium and thorium is 21 and for rare earth elements and thorium is 5. Although the present system is not suitable for separating individual rare earth elements, it is effective for separating uranium and thorium, and thorium and rare earth elements. (CFSTI)

23222 EXTRACTION OF URANIUM(VI) AND THORIUM FROM HYDROCHLORIC ACID SOLUTIONS BY TRI-n-BUTYL PHOSPHATE. Sato, Taichi (Shizuoka Univ., Hamamatsu, Japan). J. Appl. Chem. (London), 16: 53-7 (Feb. 1966).

The partition of uranium(VI) and thorium between hydrochloric acid solutions and solutions of tri-n-butyl phosphate (TBP) in benzene or kerosene was investigated at different concentrations of hydrochloric acid and solvent, and at different temperatures. An infrared spectral study was also made of the organic solutions obtained in the extraction of uranium. The effect of organic solvent on the extractions was also examined. (auth)

23223 REMOVAL OF ^{131}I FROM MILK. Murthy, G. K. (Robert A. Taft Sanitary Engineering Center, Cincinnati). J. Dairy Sci., 48: 1429-35(Nov. 1965).

Attempts were made to equilibrate the anionic resin with a synthetic salt solution containing chloride, phosphate, citrate, and hydroxide under appropriate conditions for removing >95% ^{131}I and to restore the anionic composition of the milk in a single process. Milk labeled in vitro with ^{131}I was acidified to pH 5.3 with HCl, passed through a column containing cationic resin in the Ca : Mg : K : Na cycle, and neutralized to pH 6.8 by the batch process using Dowex 2-X8 (Cl : phosphate : citrate : OH) anionic resin. The anionic resin in the Cl cycle was previously charged with an aqueous solution containing NaCl, Na_3PO_4, and $C_6H_8O_7$ and adjusted to pH 11.5 with 6M NaOH. Analysis of treated milk indicated that 96.1 ± 1.0% of ^{131}I and 92.7 ± 6.0% of excess Cl were removed, and that the neutralization process increased the citric acid content by 1.9 ± 5.7% and decreased the inorganic phosphate content by 33.5 ± 4.9%. About 13.0 ± 1.0 g of resin was required to neutralize 100 ml of milk. Since removal of ^{131}I was greatly influenced by the [OH] in the resin phase, but not by the rate and extent of neutralization, this technique of neutralizing milk was thought to be possibly adaptable to column operations. The totals of anionic components of treated and untreated milks were comparable; however, neutralization of milk decreased the Ca and Mg contents by 24 and 41%, respectively. (BBB)

23224 EXTRACTION OF SELECTED METALLIC CATIONS BY DI-ACIDIC PHOSPHORUS-BASED EXTRACTANTS, $XPO(OH)_2$, IN A KETONE DILUENT. Rao, G. S.; Mason, G. W.; Peppard, D. F. (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 28: 887-97(Mar. 1966).

Isopiestic measurements in dry methyl isobutyl ketone (Hexone), with tri-2-ethylhexyl phosphoric acid as monomeric standard, showed both mono-2-ethylhexyl phosphoric acid, $(C_2H_5 \cdot C_8H_{12}O)PO(OH)_2$, H_2MEHP, and 2-ethylhexyl phosphonic acid, $(C_2H_5 \cdot C_8H_{12})PO(OH)_2$, $H_2[EHP]$, to be essentially dimeric. The respective number of formula weights per aggregate was measured as 2.4 and 2.3. Assuming the extractants to be dimeric under extraction conditions (wet hexone) the extraction of Am(III), Eu(III), and Tm(III) and of Ca(II) and U(VI), i.e., UO_2^{2+}, in the H_2Y ($H_2Y = H_2MEHP$ or $H_2[EHP]$) (hexone) vs HCl system is presented. In H_2MEHP (diluent) vs HCl systems, comparison of extractant dependency of the K for Eu(III) was made for toluene (non-hydrogen bonding), hexone (hydrogen bond acceptor), and n-decanol (hydrogen bond donor and acceptor) as diluent. The variation of log K with Z for lanthanides(III) in 0.30 F extractant (hexone) vs 0.0625 F HCl showed $H_2[EHP]$ to be the more promising extractant for mutual separation of lanthanides(III). (auth)

23225 AN APPLICATION OF ION EXCHANGE RESIN TO THE UNFILTERED SLURRY TREATMENT. Baba, Riichi; Imagawa, Koji (Resources Research Inst., Kamaguchi, Japan). J. Mining Met. Inst. Jap., 81: 1053-7 (Dec. 1965). (In Japanese).

A new method of application of ion exchange resin to unfiltered uranium-bearing slurry is described. The slurry is prepared by removing sands through 150 mesh screen. Special ion exchange equipment is used. Pregnant slurry is fed into a cylindrical contactor from the bottom through a distributor, and ion exchange resin is fed from a feeder. The resin is retained in the contactor by 50 mesh screen. A rake in the contactor rotates slowly to facilitate uniform contacting. The barren slurry overflows. Under optimum conditions, recovery of uranium from the slurry is above 95%. (TCO)

23226 REMOVAL OF IODINE FROM THE ATMOSPHERE BY CONDENSING STEAM. Stinchcombe, R. A.; Goldsmith, P. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Energy, Pt. A/B, 20: 261-75 (Apr. 1966).

Some experiments have been carried out on the removal of iodine at low concentrations (less than 1 $\mu g/m^3$) from air by condensing steam from a mixture of steam and the air in a 2 in. diameter water-cooled tube. The results indicated that with an airflow of 10 l/min, steam condensing at a rate of 3–5 g/min, could effect the removal of about 97% of the elemental iodine, 50% or less of gaseous iodine compounds, and about 95 to 99% of iodine attached to particulate material. (auth)

23227 SEPARATION OF CARRIER-FREE ^{115m}In FROM ^{115}Cd BY ION-EXCHANGE CHROMATOGRAPHY. Toerko, Janos (Orszagos Atomenergia Bizottsag Izotop Intezete, Budapest). Magyar Kem. Foly., 72: 17-18(Jan. 1966). (In Hungarian).

Separation of ^{115m}In from ^{115}Cd was achieved by means of ion-exchange chromatography over a 0.8× 5 cm column packed with Dowex 1 × 8. ^{115m}In was eluted with 0.15N hydrochloric acid, and ^{115}Cd with 1.0N nitric acid. The method permits rapid, selective, and quantitative separation by a simple procedure. (auth)

23228 SYNERGISTIC AND ANTAGONISTIC EFFECTS IN ORGANIC SOLVENT EXTRACTION OF VARIOUS METALS. Bakos, L. (Central Research Inst. for Physics, Budapest); Szabo, E.; Andras, L.; Iyer, Narayan. pp 241-54 of Proceedings of the Symposium on Coordination Chemistry. Beck, Mihaly T. (ed.). Budapest, Akademiai Kiado, 1965.

Investigations were made on the extraction of U(VI) into mixtures of acetylacetone and neutral phosphate esters such as TBP, TCHP, TPhP, and on the extraction of Eu(III) and Am(III) into a mixture of HDBPA and TBP. A synergistic enhancement was observed in the system of U(VI), while an antagonistic effect was found in the case of Eu(III) and Am(III) ions. Mechanisms are proposed on the basis of association reactions. (auth)

23229 THERMODYNAMIC CALCULATION OF THE DISTRIBUTION COEFFICIENT BETWEEN THE LIQUID AND SOLID PHASES OF AN ELEMENT IN DILUTE SOLUTION IN A METAL: APPLICATION TO THE PURIFICATION OF BERYLLIUM. Desre, P. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France); Schaub, B.; Bonnier, E. pp 493-500 of STI-PUB-109(Vol.1). (In French).

The distribution coefficient Γ_i between the liquid and solid phases of an element i in the presence of other elements j in a solvent M ($\Gamma_i = x_i'/x_i$, where x_i' and x_i are the atomic

fractions of i in the solid and liquid phases respectively) was calculated from the thermodynamic properties of binary systems of the type (i,M), (j,M) and (i,j). It is shown that the interaction of all the elements present may, under certain conditions, strongly affect the value of the coefficient Γ_i. This effect is pronounced if the following condition is fulfilled: $\gamma^{\infty}_{i(M)} \cdot \gamma^{\infty}_{j(M)} > \gamma^{\infty}_{ij}$ where $\gamma^{\infty}_{i(M)}$, $\gamma^{\infty}_{j(M)}$, and γ^{∞}_{ij} are the limiting activity coefficients of the constituents i and j in the (i,M) (j,M) and (i,j) liquid state systems. It is a simple matter to deduce from this condition an application to the purification of metals by the zone-melting method; the condition enables one to chose an element j which is added deliberately to a metal in order to facilitate the elimination of an element i (subsequent elimination of the element j being also, of course, a simple matter). For example, the addition of aluminium to beryllium enables one to improve the elimination of iron during the purification of the beryllium by the zone-melting technique, the aluminum acting as a carrier. (auth)

23230 SEPARATION OF THE RARE EARTHS BY LIQUID ION EXCHANGE. I. INVESTIGATION OF THE ION EXCHANGE PROPERTIES OF DINONYLNAPHTHALENESULFONIC ACID BY PAPER CHROMATOGRAPHY WITH REVERSED PHASES. Werner, G. (Karl-Marx-Univ., Leipzig). Z. Chem., 5: 147-8(1965). (In German).

In the usual extraction methods for rare earths an additive separation effect based on the different stabilities of complexes in the aqueous phase cannot be applied because the partition coefficients and the stabilities both increase with increasing atomic number; this possibility was tested with dinonylnaphthalenesulfonic acid (HD). Chromatographic paper was impregnated with HD in heptane, dried, set up with 20 μg rare earth samples and eluted with HCl solutions of various concentrations. The chromatograms were developed with 0.1% 1-(2-pyridylazo)-2-naphthol in alcoholic ammonia solution. The dependence of the R_f on HCl concentration is illustrated for La. The dependence of log R_M on H ion concentration is illustrated for Gd and dependence of log R_M on HD concentration in the impregnating solution is illustrated for Y. The R_M values decreased with increasing atomic number, but not sufficiently to effect complete separation by this technique. Enrichment, however, is possible. (BBB)

23231 SEPARATION OF THORIUM FROM ACCOMPANYING ELEMENTS AND OBTAINING CONCENTRATES BY ION-EXCHANGE CHROMATOGRAPHY. Nabivanets, B. I.; Kudritskaya, L. N. (Inst. of General and Inorganic Chemistry, Kiev). Zh. Anal. Khim., 21: No. 1, 40-5(1966). (In Russian).

On the basis of different states of Th^{4+} and other elements in 5N $HClO_4$ and of the effect of SO_4^{2-} ions, an ion exchange chromatographic method was developed for thorium separation by means of KU-2 as the cation exchange resin. Thorium is sorbed by the resin from 5N $HClO_4$ + 0.1N H_2SO_4 and other elements with the exception of some rare earths and Nb(V) pass into the filtrate. Rare earths are selectively eluted with a 1M solution of NH_4Cl (pH ≈ 5), thorium is extracted with a 0.5M NH_4HSO_4 solution (pH ≈ 2). Niobium is eluted with a mixture of 1M H_2SO_4 + 0.5M H_2O_2. The method was used for concentrating thorium from considerably diluted solutions (about 10^{-8} – 10^{-3}M). The concentration factor is about 1000. (auth)

23232 FLUORINATION AND COLD TRAP EQUIPMENT (Engineering Materials). (Oak Ridge Gaseous Diffusion Plant, Tenn.). (CAPE–1275).

31 drawings.

The enriched oxide fluorination process is part of the facility that recovers U from aqueous wastes. In the facility the U is processed to oxides and reacted with fluorine to UF_6, which is then refed to the gaseous diffusion cascade at the point of matching isotopic analysis. Flowsheets for the process, piping and electrical drawings, and cold trap equipment are included in the package. The trap equipment includes filters, finned tubes, jackets, and designs for 3, 5, and 10 in. cold traps. (For details, see TID-4100.) (F.L.S.)

23233 METHOD FOR THE PRE-DECONTAMINATION OF NUCLEAR FUEL TO BE REPROCESSED. Vogg, Hubert (to Gesellschaft fuer Kernforschung mbH). German Patent 1,206,594. Dec. 9, 1965. Filed Dec. 31, 1964.

The nuclear fuel is decomposed in an oxidizing alkaline melt. The solidified melted material obtained is leached out with water or sodium hydroxide. Diluted acid is added to the remaining precipitate whereby the nuclear fuel is dissolved. The method was improved in that the melt for the decomposition of the nuclear fuel consists at least partially of salts of alkaline earths. (Gmelin Inst.)

23234 METHOD FOR SEPARATING AND CONCENTRATING URANIUM FROM URANIUM ORE BY CHLORINATION. Fujisaki, Tatsuo (to Agency of Industrial Science and Tech.). Japanese Patent 1964-3015. Feb. 17, 1965. Filed Oct. 12, 1959.

In the proposed method the concentration apparatus is directly connected to the chlorination apparatus. The uranium ore is chlorinated, and the uranium chloride is led to the condenser where the uranium is separated and concentrated. Either an alkali or alkaline earth chloride, oxide, carbonate, or other compound that reacts with the unreacted chlorine to form their chlorides is used to pack the condenser. The fused chloride containing more uranium is collected from the condenser. The chlorinated waste gases are exhausted. An acid-resistant packing material was found to be the most suitable for the concentration apparatus, and the alkali or alkaline-earth chloride was found very effective for lowering the vapor pressure of uranium chloride, making it easier to collect the chlorinated uranium. Even at high temperatures, if such a chloride exists, uranium can be collected efficiently, and furthermore, at these temperatures, the vapor pressures of other chlorides (besides uranium) can be elevated, thereby considerably increasing the concentration and separation of uranium. (TCO)

ENGINEERING

General

Refer also to abstract 24679.

23235 PROBLEMS ON THE PRODUCTION OF THIN FILMS. Reichelt, W. (W. C. Heraeus GmbH, Hanau, Ger.). Vakuum-Tech., 15: 2-8(Jan 1966). (In German).

The advances attained in sputtering as well as in coating by evaporation at ultrahigh vacuum together with conventional coating by evaporation in large production plants during the recent years are treated. The part on sputtering contains the production of ions by means of thermionic emission, the sputtering of insulators, and the influence of substrate bias. The second part discusses the relations between the residual gas impact rate and the lattice defects incorporated in the film together with technological problems of coating in ultrahigh vacuum. The third part presents experimental work from large production plants, highly evacuated, also the influences of temperature, condensation-speed and surface condition of the substrate on the condensed layer. Electron-beam evaporation sources are described. The last section informs about the evaporation of alloys and compounds. (auth)

Applications of Nuclear Explosions

Refer also to abstract 23342.

23236 (ORNL-TM-1496) CHEMICAL APPLICATIONS OF NUCLEAR EXPLOSIONS (CANE). Progress Report, January 1–March 31, 1966. Blake, C. A. Jr.; Brown, K. B.; Crouse, D. J. (Oak Ridge National Lab., Tenn.). Apr. 20, 1966. Contract W-7405-eng-26. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Studies were continued on the possible behavior of radionuclides that would be present in the copper recovery process as a result of using nuclear explosives for breaking the ore. In a column leaching test with a mixture of copper ore and test shot rubble, over 80% of the copper was recovered and about 8% of the ^{106}Ru in the system reported to the copper product. Ruthenium contamination was reduced by treating the cementation barren liquor with lime. Attempts to remove ruthenium from the leach liquor by adsorption on activated carbon were not very successful. After 145 days of mixing methane and tritiated water vapor at 100°C, 1 atm, and 1 mC/liter tritium, sufficient exchange of tritium and hydrogen had taken place to show that the rate of formation of tritiated methane is approximately 2.5×10^{-6} mC/liter-day. A sample of Green River oil shale was crushed for use in laboratory retorting experiments. The shale yields about 30 gal oil/ton shale in modified Fischer retorting tests. A sample of the shale was irradiated and the activation products identified thus far are ^{46}Sc, ^{59}Fe, ^{54}Mn, ^{51}Cr, ^{124}Sb, and ^{65}Zn. (auth)

23237 (UCRL-14171) PRINCIPLES OF NUCLEAR EXCAVATION. Nordyke, Milo D. (Lawrence Radiation Lab., Univ. of California, Livermore). May 25, 1965. Contract W-7405-eng-48. 31p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Basic cratering concepts and the present state of nuclear excavation technology are described. The general nature of the safety hazards associated with nuclear excavation are also discussed, and specific applications of nuclear excavation techniques to a large-scale construction project are briefly outlined. It was concluded that nuclear explosions are capable of making craters that are suitable for many large-scale construction projects and that, with appropriate safeguards and studies, they can be used safely. Nuclear excavation costs in hard rock are estimated to be competitive with conventional excavation in 10-kt range, rapidly decreasing to a few cents per cubic yard in the megaton range. (P.C.H.)

23238 NUCLEAR EXPLOSIVES—A NEW LABORATORY. Dorn, D. W. Discovery, 27: 26-9(Mar. 1966).

The use of nuclear explosions for research is described. The properties of these explosions are considered, experiments using such explosions are described, and future experiments are discussed. Geophysical studies, plasma production for astrophysics, the production of neutrons in reactors, the time-of-flight analysis, element synthesis by neutron capture, and a possible use of reactors for the cross linking of polymers from gamma-ray production are considered. (J.F.P.)

Facilities and Equipment

Refer also to abstracts 23086 and 23628.

23239 (AEC-tr-6466/1, pp 226-34) UNIVERSAL CANYON WITH AN ANNULAR CHANNEL FOR POWERFUL GAMMA-RAY SOURCES. Mamin, E. V.; Moiseenko, P. P.; Perkarskii, N. A. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A shielded canyon with an annular channel is proposed for use in irradiation facilities with powerful gamma sources. The relative reduction of the quantity of shielding material in a canyon with an annular channel in comparison to a canyon with a conventional labyrinth is calculated. A shielded canyon containing a source with an activity of 10^5 g-equivalent of radium is described. (D.C.W.)

23240 (AEC-tr-6466/1, pp 235-7) EXPERIMENTAL STUDY OF SOME SHIELDING PROBLEMS RELATED TO THE USE OF RADIOCHEMICAL INSTALLATIONS EQUIPPED WITH POWERFUL SOURCES OF GAMMA RADIATION. Breger, A. Kh.; Gurvich, S. S.; Pozdnyakova, L. A.; Chistov, E. D. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The distribution of the dose-rate field in the labyrinths of two irradiation facilities using powerful gamma sources was measured, and the energy of the scattered gamma radiation was determined. It was found that the dose-rate fields in both installations are determined principally by the scattered radiation. Calculations of the dose rates were also made. (D.C.W.)

23241 INDUSTRIAL RADIOELEMENT IRRADIATORS. Brunelet, L.; Frignet, G.; Rondenay, F. Bull. Inform. Sci. Tech. (Paris), No. 99, 49-55(Dec. 1965). (In French).

Two radio-element irradiators having industrial-type characteristics were brought into operation in France during 1965: the mobile independent irradiator IRMA, now based at Saclay, which is charged with 173,000 curies of cesium-137; the fixed swimming-pool type irradiator at Dagneux which was recently modernized, equipped with a new conveyor and charged with cobalt-60. The two installations are described. (auth)

23242 BIOLOGICAL EFFECTS OF IONIZING RADIATION ON MILK SYNTHESIS. I. A ^{60}Co IRRADIATOR, BOSSY NOVA-MARK 1. Luick, J. R. (Univ. of California, Davis). J. Dairy Sci., 48: 1615-17(Dec. 1965).

A ^{60}Co irradiator for irradiating the mammary glands of lactating dairy cows and goats is described. Design features include: a uniform distribution of energy throughout the exposed tissue, and almost complete containment of the primary γ-ray beams within the selected system. The time required to deliver a predetermined dose to the center of each mammary gland was calculated from a graph constructed from data obtained in calibration studies made with bovine mammary gland and ionization chambers.

Trials of the 85-C source on more than 50 animals proved the device mechanically and operationally superior to x-ray sources. (TCO)

23243 ON A ^{60}Co γ-RAY IRRADIATION LABORATORY OF KYUSHU UNIVERSITY. I. OUTLINE OF THE IRRADIATION FACILITY. Sonoda, Masaaki; Takayanagi, Motoo (Kyushu Univ., Japan). Technol. Rep. Kyushu Univ., 38: 45-52(Mar. 1965). (In Japanese).

The Kyushu University ^{60}Co γ-Ray Irradiation Laboratory was designed primarily for non-biological experiments requiring large doses. Some flexibility for biological experiments is provided by changing irradiation positions. The cage-type ^{60}Co gamma-ray source of 3000 curies consists of 24 capsules packed with ^{60}Co pellets, and arranged on the 10.5-cm circumference. For irradiations the source is raised from below the irradiation room. The irradiation facility includes the source container, the drive mechanism for the source container and its shutter, the irradiation table, controls, safety devices, the winding hoist, and the embedded framework. The radiation source and its shutter are driven by an electrical drive mechanism; these can also be operated manually if necessary. The irradiation equipment, including the table, can be operated remotely. (tr-auth)

23244 AIR SAMPLER /Q-2282/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE–1289). 3 drawings.

An air sampler for building 3027 (Source and Special Materials Facility) is described. A vacuum pump and flowmeter are employed. The carbon vane motor pump must be a Model 0211 V36 G10x or equal rotary pump operating at 1750 rpm under a 6 in. Hg vacuum. The flowmeter recommended is a Fisher and Porter Model 10A 3135 or equal. (P.C.H.)

23245 AIR SAMPLER ENCLOSURE (Engineering Materials). (Lawrence Radiation Lab., Univ. of California, Livermore). (CAPE–1338). 8 drawings.

The weatherproof enclosure is used to house high-volume air samplers which are utilized at selected sites to give data concerning contamination. The enclosure is 20 × 20 × 27½ in. high, with louvers 12½ in. long × 8¼ in. wide on three sides. Framing is angle mild steel 1 × 2½ × 1/16 in. and the panels are fabricated of 22 gauge mild steel. (P.C.H.)

23246 ANALYSIS OF TWO HIGH-TEMPERATURE LIQUID METAL PRESSURE MEASURING SYSTEMS. Cassano, Anthony J. (Consolidated Controls Corp., Bethel, Conn.). 6p. (CONF-650655–1). ORINS. Gmelin, AED-CONF-65-159-1.

From Aerospace Technical Conference and Exhibit, Houston, Tex.

A design approach to a high-temperature pressure transducer system for use in closed-cycle liquid-metal facilities utilizes the displacement of a diaphragm member by the liquid metal pressure. The displacement is then monitored by a suitable transduction device whose output indicates the pressure. A main problem area involves the pertinent characteristics of the transducer. Analyses of two transduction system approaches based on thermionic and on variable impedance phenomena are presented. (auth)

23247 MACHINES FOR REMOVING SPLITTER BLADES FROM NUCLEAR REACTOR FUEL CANS. Buckley, Frank Hollins (to Fairey Engineering Ltd.). British Patent 1,022,126. Mar. 9, 1966. Filed Nov. 30, 1962.

A machine is provided for removing the splitter blades from used fuel element cans by remote operation. The can with its splitter blades is supported in the machine, and the cutter mechanism is constructed and arranged to sever the strap securing means of the splitter blades to the can. A withdrawal mechanism is constructed and arranged to grip a splitter blade and withdraw it in the generally radially outward direction from the fuel can. A control means is provided to actuate the cutter and withdrawal mechanism in the appropriate time sequence. (B.L.M.)

23248 AUTOMATIC SAMPLE CHANGER. Triviere, Raymond (to Ateliers de Constructions Electriques de Charleroi). German Patent 1,204,341. Nov. 4, 1965. Priority date Nov. 14, 1962, Belgium.

The automatic sample changer consists of sample holders of magnetizable material, which are driven on a horizontal, continuous plane by a transport device located below the plane. This transport device consists of permanent magnets mounted on a movable endless belt conveyor. The transport device moves the samples in front of a lateral opening in the measuring chamber from where they are transported into the chamber by a suitable shielded pushing device and elevated by an elevating mechanism in the chamber in front of the detector. (Gmelin Inst.)

23249 METHOD FOR DETECTING LEAKS WITH A RADIOACTIVE GAS. Watanabe, Toshihide (to Nippon Electric Co., Ltd.). Japanese Patent 1964-9120. May 12, 1965. Filed Apr. 24, 1961.

In testing sealed containers for leakage, the containers are placed in a large tank filled with pressurized radioactive gas and tested for radioactivity after removal from the tank. In the method proposed, the testing tank in which the sealed containers are placed is connected to a radioactive gas tank and to a liquid tank. The liquid is introduced into the testing tank to displace air, and then the liquid is displaced by radioactive gas. After the sealed containers for testing are exposed to the pressurized gas, the radioactive gas is drawn out into its container, and the liquid simultaneously displaces the gas in the tank. (TCO)

23250 IRRADIATION METHOD. Komai, Kenichiro (to Hitachi, Ltd.). Japanese Patent 1964-12000. June 14, 1965. Filed Nov. 4, 1962.

A method is proposed for irradiating materials with a mixture of electrons and x rays. Part of an electron beam accelerated in an accelerator is made to impinge upon an x-ray producing target. The remaining large part of the electron beam is admixed with the x rays produced, and the two radiations are allowed to irradiate the material at essentially the same time. A greater effective depth of irradiation is achieved than with the electron beam alone. (TCO)

23251 NEUTRON GENERATOR. Komai, Kenichiro (to Hitachi, Ltd.). Japanese Patent 1964-15639. July 21, 1965. Filed Oct. 16, 1963.

The neutron generator proposed is so constructed that neutrons are produced only when a sample material to be irradiated is in the irradiation compartment. In front of the irradiation compartment a device is installed for detecting the passage in or out of a sample material to be irradiated. By the output signals of this device, the electromagnet for driving a rod is energized; this rod operates the ion source. Thus, when the sample material is in the compartment, ions are ejected to produce the neutrons. (NSA of Japan)

Heat Transfer and Fluid Flow

See also PHYSICS – Fluid Physics and Thermodynamics

23252 (IDO–14650) PARTICLE GROWTH AND SIZE DISTRIBUTION IN FLUIDIZED BED PROCESSES: A MATHEMATICAL MODEL WITH COMPUTER SOLUTIONS. Grimmett, Earl S. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 1966. Contract AT(10-1)-205. 53p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

A mathematical model describing particle dynamics in fluidized bed processes is presented. The model includes the important factors of particle growth, particle attrition, elutriation of particles from the surface of the bed, and the addition of seed particles to the bed. Mathematical equations are presented describing both the steady state and unsteady state particle size distribution in the bed. Digital

computer solutions of the unsteady state model are presented to demonstrate its applicability to actual fluidized bed processes, and the computer code for solving the unsteady state equation written for an IBM-7040 computer is also presented. (auth)

23253 (LNF–66/13) STATO ATTUALE DELLE TECNICHE DI COSTRUZIONE DI MAGNETI SUPERCONDUTTORI. (Present State of the Construction Techniques of Superconducting Magnets. Note No. 312). Pasotti, G.; Sacchetti, N.; Sacerdot, G.; Sanna, G. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Mar. 11, 1966. 14p. Dep. mn.

The present state of the techniques of constructing superconducting magnets is reviewed. The methods used for the preparation of magnet materials and the type of superconducting magnets constructed are discussed. The uses of superconducting magnets are briefly indicated. (J.S.R.)

23254 (NYO–3114-14) TWO-PHASE FLOW AND BOILING HEAT TRANSFER. Final Report. Wallis, G. B. (Thayer School of Engineering, Dartmouth Coll., Hanover, N. H.). Feb. 1966. Contract AT(30-1)-3114. 202p. (EURAEC–1605). Dep. mn. CFSTI $6.00 cy, $1.25 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

An investigation was made of the basic properties of two-phase flows and their relevance to engineering design. Certain "flow regimes" were chosen for study and an adequate analysis of the principal dynamic processes was sought. The following flow regimes are discussed in some detail; bubbly flow, slug flow, the transition from slug flow to annular flow in a vertical pipe, annular flow, horizontal flow, vertical flow, and droplet entrainment from a liquid film. (M.O.W.)

23255 (SAN–409-29) HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS. Summary Report. Poppendiek, H. F.; Greene, N. D.; Sabin, C. M.; (and others) (Geoscience Ltd., Solana Beach, Calif.). Jan. 1966. Contract AT(04-3)-409. 125p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

The principal results of analytical and experimental work directed toward the study of the mechanisms which control boiling heat transfer, both in linear and helical forced flow boiling, are presented. The analytical results presented consist of studies of idealized momentum and heat transfer models. The particular phase distributions studied are representative of linear and helical flow systems. In experimental work, emphasis was placed on high acceleration field helical flow boiling, with mercury and potassium as the working fluids. The majority of the forced convection experiments were performed under nearly uniform wall heat flux boundary conditions. The results were divided into two main categories, momentum and heat transfer. The analytical work was further classified on the basis of simplified types of phase distributions. (M.O.W.)

23256 CALCULATION OF VELOCITY DISTRIBUTIONS IN ROD CLUSTERS. Rapier, A. C.; Redman, J. D. (United Kingdom Atomic Energy Authority, Seascale, Eng.). J. Mech. Eng. Sci., 7: 460-8(Dec. 1965).

A method of calculating velocity distributions in rod-cluster flow passages is described and is shown to be in good agreement with experimental observations in two particular cases. (D.C.W.)

23257 STEAM VOLUME FRACTION OF TWO-PHASE FLOW. Michiyoshi, Itaru; Shirataki, Koji; Takitani, Koichi (Kyoto Univ.). Nippon Genshiryoku Gakkaishi, 8: 16-24(1966). (In Japanese).

The steam-volume fraction of two phase mixture flowing upward under atmospheric pressure in the two vertical circular pipes of which inner diameters are 13.8 mm and 21.0 mm was measured, taking into consideration the flow patterns, with a capacitance type void meter. The steam volume fraction and slip ratio vary with steam weight fraction (steam quality) x in different fashions for different flow patterns. For example, the slip ratio increases with increasing the steam quality, but its slope decreases as the bubble flow ($x < 0.1\%$) changes into slug flow ($0.1\% < x < 0.5 \sim 1\%$) and the slug flow into annular flow ($x > 0.5 \sim 1\%$). The effect of superficial velocity V_0 on slip ratio S is most significant in the region of annular flow, and S decreases as V_0 increases from 30 cm/s to 100 cm/s. For bubble flow, taking account of the effect of wake of bubbles, a theoretical equation to predict its slip ratio and steam volume fraction was derived. This equation satisfies not only the present experimental results but also the experimental data under high pressure obtained by several investigators. For slug flow, the present experimental results were compared with Moissis, et al.'s experiments which discussed the development of slug. (auth)

23258 GRAVITATIONALLY UNSTABLE LEIDENFROST STATE (FILM BOILING) OF LOW BOILING POINT LIQUID ON A HORIZONTAL SURFACE. Frederking, T. H. K.; Wu, Y. C.; Clement, B. W. (Univ. of California, Los Angeles). New York, American Inst. of Chemical Engineers, 1965, Preprint No. 8b, 22p.; $0.50. (CONF-650559–6). ORINS.

From American Institute of Chemical Engineers, 56th National Meeting, San Francisco.

The Leidenfrost state of liquid helium I (above the λ-point) on a large horizontal surface is discussed. Heat transport data of importance for many Dewar configurations were obtained. Experimental results for room-temperature liquids were extended to very small values of the governing group of physical parameters (Rayleigh number) and correlations for elevated temperatures were subjected to a severe test by using a liquid with very different equilibrium state and transport properties. The case of gravitational instability established with pure saturated liquid is considered. Known dispersion relations describing gravitational stability effects on interfacial wave motion were used to work out four simple cases. Experimental tests of the results were carried out in a helium cryostat at a pressure of 1 atm with thermocouple thermometry. Data are presented in graphs. Surface tension was found to be unimportant as far as film boiling heat transport at large surfaces is concerned. It was concluded that irregular kinematic conditions prevail at large surfaces, therefore, all relations based on kinematic regularity, such as minimum flux relations and bubble frequency-diameter functions, are special results. (M.C.G.)

Materials Testing

Refer also to abstracts 23660, 24681, 24684, and 24685.

23259 (AEC-tr–6466/1, pp 131-4) THE USE OF BREMSSTRAHLUNG IN FLAW DETECTION. Balabina, G. V. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The results of an investigation of the use of bremsstrahlung in flaw detection are presented. (D.C.W.)

23260 LIMITS OF FAULT DETECTION ON STEAM PRODUCING TUBES FOR NUCLEAR POWER PLANTS. Kuhlmann, A. (Technischer Ueberwachungs-Verein Rheinland, Cologne); Adamsky, F.-J. Atomwirtschaft, 11: 174-8(Apr. 1966). (In German).

Non-destructive testing methods, construction, and manufacturing technological precautions in its installation, and limits of the fault detection are described for a steam generator constructed for a nuclear power plant. Ultrasonic tests, tests of the tube curvature, and tests of the weld seam are described. The cost economics are also considered. (J.S.R.)

23261 NON-DESTRUCTIVE TESTING METHODS FOR NUCLEAR FUELS. II. Manabe, Katsumi (Furukawa Electric Co., Ltd., Japan). FAPIG (Tokyo), No. 37, 112-15 (July 1965). (In Japanese).

The nondestructive testing methods described include ultrasonic flaw detections, eddy-current flaw detections, He leak tests, and observations of surface contaminations. In the ultrasonic flaw detections, a comparison is made of the various available techniques for flaw detection in uranium metals, fuel claddings, and fuel and cladding materials. For cladding ceramic fuels, small tubes of thin wall thickness are usually used. To detect minute flaws in such claddings, either the ultrasonic or eddy-current method is best. For detecting flaws in extrusion materials, the ultrasonic reflection technique is usually used with an oil as the contacting medium. The He leak test is most effective for detecting minute flaws in the weld of cladding tubes through which fission gases are released. For testing of surface contaminations, the advantages and disadvantages of various available methods are described. (tr-auth)

23262 ON-STREAM RADIOGRAPHY IS WORTH THE MONEY. McGregor, Alex (American Oil Co., Texas City, Tex.). Mater. Protect., 4: 26-32(Oct. 1965).

Examples of the use of radiography in production lines are presented to emphasize the value of the technique as an inspection tool offering economic savings. Relative density is visualized from the radiographic interpretation, and by this means, it is possible to determine the thicknesses of insulation, pipe wall, and internal deposits on a single radiograph. Case histories at an oil refinery are used to illustrate how effective radiography can be as a tool for on-stream inspection. Radiography as an inspection tool also has many off-stream uses and other applications, particularly during plant turnarounds. To insure equipment cleanliness, for example, radiographs can be used to locate foreign material. Equipment required for radiography includes a jig for positioning the γ source, a 5-C ^{60}Co camera normally used to inspect piping larger than 8 in. in diameter and for steel thicknesses over 3 in., and a survey meter. (BBB)

23263 NONDESTRUCTIVE TESTING. SECOND EDITION. McGonnagle, Warren J. New York, Gordon and Breach Science Publishers, [1965]. 463p.

Physical principles are emphasized in a discussion of methods and techniques of nondestructive testing. Advantages, disadvantages, and limitations of the methods are considered. Visual testing, pressure and leak testing, liquid penetrant inspection, thermal methods, x-ray radiography, ultrasonics, dynamic testing, magnetic methods, electric methods, eddy current methods, and thickness measurements are discussed. (M.C.G.)

Protective Structures

23264 (AD-624701) SENSITIVITY ANALYSIS OF CIVIL DEFENSE SYSTEMS AND COMPONENTS. A COST-EFFECTIVENESS COMPUTER PROCEDURE FOR OPTIMUM ALLOCATION OF FALLOUT SHELTER SYSTEM FUND UNDER UNIFORM OR VARIABLE RISK ASSUMPTIONS. Final Report, Vol. 1. Guess, Floyd M. (Research Triangle Inst., Durham, N. C. Operations Research Economics Div.). Oct. 1, 1965. Contract OCD-PS-64-56. 88p. (R-OU-157(Vol.1)). CFSTI $3.00 cy, $0.75 mn.

The dynamics of civil defense planning and systems evaluation require a procedure that yields approximate answers to questions concerning effective fallout shelter improvement programs. To accomplish this, a computerized model for the CDC 3600 is developed and is demonstrated for OCD Region 6. The model permits an evaluation of shelter improvement programs against any fallout environment, but it is particularly valuable when RISK-type expressions of the probable fallout environment are used as inputs. Using detailed data from the National Fallout Shelter Survey and equally detailed estimates of the probable fallout hazard in a small area (counties, in the demonstration), the extent to which an area's population is inadequately protected is determined. Fallout shelter system funds are then allocated to areas of need in an optimal manner. The allocation employs shelter cost data obtained from Phase 2 of the National Fallout Shelter Survey on ventilation and shielding improvements. Estimated costs for package ventilation and shelter in new construction are also employed in the demonstration in OCD Region 6. In all, 14 cost studies are run, using selected combinations of the budget level, the fallout risk level, etc. (TAB)

23265 (AD-624702) A SENSITIVITY ANALYSIS OF SELECTED PARAMETERS BASED ON 8 SMSA'S. Final Report, Vol. 2. Sink, H. Rodney (Research Triangle Inst., Durham, N. C. Operations Research Economics Div.). Oct. 1, 1965. Contract OCD-PS-64-56. 74p. (R-OU-157(Vol.2)). CFSTI $3.00 cy, $0.75 mn.

In order to perform a sensitivity analysis of selected parameters of interest in Civil Defense systems analysis, probable casualties are estimated for 8 SMSA's over a range of fallout environments and shelter utilization patterns. The selected parameters are: SMSA population, population density, and ratio of shelter spaces to population; fallout arrival time and reference intensity; and restrictions on movement of people to shelter, leading to varying patterns of shelter utilization. The SMSA's are selected by "judgment sampling" and range in population from 74,000 to 408,000. The fallout environments used range from a reference intensity of 600 r/hr and 7 hours time of arrival to a reference intensity of 30,000 r/hr and 1 hour time of arrival. The movement-to-shelter restrictions are: movement restricted to the Standard Location (SL) of residence, movement restricted to within two miles of the SL of residence, and unrestricted movement to shelter anywhere within the SMSA. Also, the transportation algorithm is used to determine the optimal (minimum casualty) allocation of people to shelter for each time of arrival and reference intensity combination. This allocation serves as a benchmark of ideality against which to measure other patterns of shelter utilization. Casualties are computed for each of the four movement patterns over the range of attack environments. (auth)

23266 (AD-624703) SENSITIVITY ANALYSIS OF CIVIL DEFENSE SYSTEMS AND COMPONENTS. A GENERALIZED SENSITIVITY ANALYSIS OF CD SYSTEMS. Final Report, Vol. 3. Neblett, John H.; Willis, Kenneth E. (Research Triangle Inst., Durham, N. C. Operations Research Economics Div.). Oct. 1, 1965. Contract OCD-PS-64-56. 74p. (R-OU-157(Vol.3)). CFSTI $3.00 cy, $0.75 mn.

This sensitivity analysis employs mathematical models which estimate the total dose, maximum ERD, and probability of casualty or fatality for an individual exposed to a particular radiological environment. The objective of the analysis is to determine the relative importance of the parameters normally employed in evaluating Civil Defense systems i.e., to determine those parameters which, through large variance or inaccurate estimates, will contribute most to erroneous evaluations of CD systems. (TAB)

23267 (AD-627597) DESIGN PROCEDURES FOR SHOCK ISOLATION SYSTEMS OF UNDERGROUND PROTECTIVE STRUCTURES. VOLUME II. STRUCTURE INTERIOR MOTIONS DUE TO DIRECTLY TRANSMITTED GROUND SHOCK. [Period Covered], November 1963-January 1965. Finlayson, F.; Fugelso, L. E.; Shulman, Y. (MRD Div., General American Transportation Corp., Niles, Ill.). Dec. 1965. Contract AF29(601)-6253. 209p. (RTD-TDR-63-3096(Vol.2)). CFSTI $6.00 cy, $1.25 mn.

A method is presented for estimating the motions on the interior of a buried cylindrical shell resulting from directly-induced ground shock caused by the detonation of a nuclear device to aid in the preliminary design of shock isolation equipment. Various theoretical models for calculating the free-field waveform are reviewed and the acoustic model is recommended for this purpose. The reasons for this recommendation are enumerated and the methods for applying it are given. Methods for solving the structure-medium-interaction problem are discussed and the normal-mode analysis of the response of an elastic cylindrical shell in an acoustic medium to a specified input pulse is reviewed in detail. A discussion of ranges of parameters appropriate

to realistic problems is included. A thorough explanation of the results of computer solutions for the shell response is presented, and a large number of graphs illustrating the results are included. The results are analyzed to determine the relative influence of the parameters on interior shell motion. The application of the method developed is explained and illustrated by sample problems. An appendix contains a Duhamel-integral computer program that can be used to generate results for cases not included in this volume. (auth)

23268 (AD-627870) DESIGN PROCEDURES FOR SHOCK ISOLATION SYSTEMS OF UNDERGROUND PROTECTIVE STRUCTURES. VOLUME IV. RESPONSE OF TWO-DEGREE-OF-FREEDOM ELASTIC AND INELASTIC SYSTEMS. Newmark, N. M.; Walker, W. H.; Veletsos, A. S.; Mosborg, R. J. (Newmark Hansen and Associates, Urbana, Ill.). [nd]. Contract AF29(601)-6253. 206p. (RTD-TDR-63-3096(Vol.4)). CFSTI $6.00 cy, $1.25 mn.

Simple rules are developed for the designer so that he may be able to predict the maximum responses of two-degree-of-freedom elastic and inelastic systems under various types of ground shock excitation. The true responses of two-degree-of-freedom systems both in the elastic range and in the inelastic range, when subjected to five different forms of ground excitation are compared with the modal response of the same systems. Simple expressions are given for linear two-degree-of-freedom mass and spring combinations from which modal parameters can be obtained. From these modal parameters, and the response spectra for one-degree-of-freedom systems for various excitations, one can determine bounds and probable values of the response. A detailed study is reported of a two-degree-of-freedom system subjected to a step velocity pulse at the base, having various combinations of elastic and inelastic response. In addition, a series of solutions of two-degree-of-freedom systems are presented for comparison with various approximate rules for determining bounds to the response in the various springs of the system. (auth)

Space Propulsion

See also ISOTOPE TECHNOLOGY — Power Application
REACTOR TECHNOLOGY — Propulsion and Space

Refer also to abstract 24683.

23269 (N-65-14402) THIRTY-KILOWATT PLASMA-JET ROCKET ENGINE DEVELOPMENT. THIRD YEAR DEVELOPMENT PROGRAM. Summary Report, June 1, 1963-May 31, 1964. Bennett, S.; Cass, L. A. (Research and Advanced Development Div., Avco Corp., Wilmington, Mass.). July 2, 1964. Contract NAS3-2593. 245p. (NASA-CR-54079; RAD-TR-64-42). CFSTI $6.00 cy, $1.50 mn.

Thirty kilowatt radiation-cooled arcjet engines were tested for 30 days at 1000 second I_{sp} 10 days at 1300 second I_{sp} and 120 hours at 1500 second I_{sp}. The measured efficiency range was 40 to 45 percent. Results of an extensive high-temperature bonding study are reported. At the 200-kilowatt power level, a specific impulse level of 2000 seconds was reached with a radiation-cooled engine, and a specific impulse level of 7400 seconds was reached with a liquid-cooled engine—also in the 40-percent efficiency range. Probe measurements were made in the 30-kilowatt engine exhaust, and are compared with predictions of the core flow model. Measurements were made of the constricted arc voltage gradient. (auth)

23270 (N-66-16038) PERFORMANCE STUDY OF A REPETITIVELY PULSED TWO-STAGE PLASMA PROPULSION ENGINE. Final Report. Gorowitz, B.; Gloersen, P.; Rowe, J. H. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). Nov. 20, 1963. Contract NAS3-2502. 113p. (NASA-CR-55248). CFSTI $4.00 cy, $0.75 mn.

The study of the performance of the repetitively pulsed, two-stage coaxial plasma engine is continuing. Data were obtained in the following categories: the operating characteristics of the major components of the existing engine system; performance trends associated with change of design and operating parameters; and correlation of experimental results with those predicted by an analytical model. An accelerator efficiency of 43% was obtained, and no insurmountable problems were indicated. Further optimization of the performance of this engine will depend upon appropriate matching of the characteristics of the electrical circuits to the geometrical characteristics of the accelerator and the density and distribution of the propellant load. (STAR)

23271 (NASA-TN-D-3407) THRUST MEASUREMENT OF SERT I ION THRUSTORS. Nieberding, William C.; Lovell, Robert R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr. 1966. 41p. CFSTI $2.00 cy, $0.50 mn.

A description and an analysis of the thrust detection systems aboard the SERT I (Space Electric Rocket Test) ion thrustor flight test are given. Two types of thrust detection were employed: (1) sun sensor spacecraft spin period detectors and (2) a radial accelerometer centripetal acceleration detector. The thrust of a 22-millinewton ion thrustor produced a rate of change of spacecraft spin of approximately 0.01 percent per second. This change was measured by both detection systems to yield direct thrust measurements agreeing to within 5 percent for 10- to 30-second averages. The radial accelerometer was also used as a very sensitive precession detector. The precession half-cone angle of the spacecraft was measured to be 5.3×10^{-4} radian (0.03°). (auth)

23272 (TG-230-T464) OPTIMAL COMBINATION OF PROPULSION SYSTEMS. Ivanov, Yu. N. Translated by W. R. Blake (Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.), from Izv. Akad. Nauk SSSR, Mekh., No. 2, 9-18(1964). 17p.

A method is considered of solving the variational problem of the optimal combination of arbitrary propulsion systems, and a study is made of the problem of the optimal combination of engines of limited exhaust velocity with engines of limited power. The weight of an engine of limited exhaust velocity is considered as being proportional to the maximum thrust; the weight of an engine with limited power is assumed in one case to be proportional to the maximum power, and in another case to be equal to the sum of two terms, one of which is proportional to the maximum power and the other to the maximum thrust. (auth)

23273 ENVIRONMENTAL ASPECTS OF NUCLEAR SPACE PROPULSION. Selph, Wade E. (Ling-Temco-Vought Astronautics Div., Dallas). pp 145-50 of Institute of Environmental Sciences 1965 Annual Technical Meeting. Mt. Prospect, Ill., Institute of Environmental Sciences, 1965.

The various types of nuclear propulsion systems are outlined, and the implications of the associated radiation environments are discussed in some detail. (D.C.W.)

Vacuum Engineering

23274 DEVELOPMENT, DESIGN AND PERFORMANCE OF A NEW, AXIALLY SYMMETRICAL SPUTTER-ION PUMP. von Ardenne, M.; Roth, H.; Lorenz, E. Vakuum-Tech., 15: 8-14(Jan. 1966). (In German).

Sputter-ion pumps of simple design and operation are described. The development started in the Dresden laboratories already in 1955 with prototypes using flat cathodes made of vacuum melted titanium, and a homogeneous magnetic field. Further investigations lead ultimately to an axially symmetrical design with cylindrical cathodes and a radically oriented inhomogeneous mag-

netic field. Noncutting forming is applied for making the pot shaped pump body and some of the cylindrically shaped electrodes. The pump body is made of nonmagnetic stainless steel. Speed ratings to date are between 1 and 100 litres per second. Due to the geometry of the pump the current lead-in is within the profile of the pump body and thus protected against mechanical damage. The ω-shaped permanent magnet is made of Alnico 400 Mv-material and can be baked up to 450°C. The magnet can, if required, easily be removed from the pump. The connecting flange is so designed that the electrodes are easily accessible. Some of the experimental results are presented. Ultimate pressure is below 10^{-10} torr. (auth)

23275 A NEW CRYO PUMP WITH A VERY LOW COOLANT CONSUMPTION, DESIGNED FOR WORKING TEMPERATURES BELOW 4.2 DEG K. Kienel, G.; Wutz, M. (Heraeus Hochvakuum GmbH, Hanau, Ger.). Vakuum-Tech., 15: 40-6(Feb. 1966). (In German).

A cryo pump similar in design to a liquid cooled cryostat and equipped with a blackened liquid-nitrogen cooled radiation shield is described. The working temperature may be varied between 1.5 and 4.2°K, the consumption of liquid helium (20 $cm^3 \cdot h^{-1}$) being independent of the working temperature within the range 2.2 to 4.2°K. At lower temperatures the consumption increases by 10 $cm^3 \cdot h^{-1}$. The pumping speed of this cryo pump is 2,900 liter/sec for air and 11,000 liter/sec for hydrogen. The calculated pumping speed for water vapor is 32,000 liter/sec. (auth)

23276 A MANY-TIMES RE-USABLE METAL SEAL FOR BAKEABLE ULTRA HIGH VACUUM VALVES AND FLANGE GASKETS. Kienel, Gerhard; Wanetzky, Erwin (Heraeus Hochvakuum GmbH, Hanau, Ger.). Vakuum-Tech., 15: 59-61(Mar. 1966). (In German).

A hand-operated ultra high vacuum valve has, as sealing part, a circular section of copper sheeting bearing an electroplated coating of pure gold. This sealing part is pressed onto a seating of stainless steel. The valve can be operated several hundred times in the temperature range between room temperature and 350°C before the easily interchangeable copper-based section needs replacing. It also remains vacuum-tight throughout repeated bake out cycles between room temperature and 350°C. Copper rings coated with gold, can—as established by long-series experiments—be used at least 6 or 7 times, even where the flange and sealing ring are forced counter to each other on unbolting. (auth)

GEOLOGY, METEOROLOGY, AND MINERALOGY

General

23277 EFFECTS OF HUMUS ON ^{90}Sr DIFFUSION RATE IN QUARTZ SAND. Prokhorov, V. M.; Frid, A. S. Pochvovedenie, No. 3, 68-70(Mar. 1966). (In Russian).

The coefficient of diffusion of ^{90}Sr in damp finely divided quartz sand was strongly altered by the introduction into the sand of humic acid. The introduction into pure sand of 2% humic acid decreased the coefficient of diffusion 10 times. The speed of ^{90}Sr diffusion with similar concentration of humus and identical dampness was higher in natural soils than in the quartz sand to which humic acid had been added. The principal cause lies possibly in the different concentrations of humus in the two types of soil. (tr-auth)

23278 DISPERSED AND NOT-SO-RARE EARTHS. Haskin, Larry A.; Frey, Fred A. (Univ. of Wisconsin, Madison). Science, 152: 299-314(Apr. 15, 1966).

The reflection of the earth's geochemical evolution from primordial matter in the relative abundances of the rare earths is discussed. The averages for the rare earth contents of 20 chondrites and the rare earth content of a composite of 40 North American shales are given. Data for various individual sedimentary rocks and igneous rocks were also analyzed. The distribution patterns for the rare earths in chondrites and in the weathered portions of the earth's crust were identical for gadolinium and lutetium. Data suggested that the average rare earth pattern for the whole earth matches the chondritic pattern, and that the distribution characteristic of the upper crust is a result of geochemical differentiation. (M.C.G.)

23279 OZONE AND WATER VAPOUR IN THE UPPER TROPOSPHERE AND LOWER STRATOSPHERE. Murgatroyd, R. J. WMO (World Meteorol. Organ.), Tech. Note No. 68, 68-94(1965).

Methods of measurement of ozone and water vapor in the upper troposphere and lower stratosphere are reviewed. Available information on the following is summarized: the vertical profile of humidity, the latitudinal distribution of humidity, formation of ozone in the atmosphere, the vertical and horizontal distribution of ozone, short-period variation of ozone, and aircraft observations of latitudinal variation of ozone and humidity. Application of this knowledge to the problem of the general circulation in the stratosphere and interchange with the troposphere is discussed. (101 references) (A.G.W.)

23280 RADIOISOTOPE TECHNIQUE FOR MONITORING SEDIMENT CONCENTRATION IN RIVERS AND STREAMS. Papadopoulos, J.; Ziegler, C. A. (Parametrics, Inc., Waltham, Mass.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-68/26, 19p. (CONF-651023-13). ORINS.

From Symposium on Radioisotope Instruments in Industry and Geophysics, Warsaw.

The problem of determining the amount of sediment carried by natural and man-made waterways is considered. To satisfy the need for a self-powered, continuous monitoring system, a gage based on the use of radiation from a radioisotope source was developed. The advantages of using a radioisotope technique are twofold: because a beam of radiation is used as the sensing agent, the water and sediment are not perturbed, as occurs with mechanical sampling methods, permitting greater accuracy and radioisotope techniques lend themselves to applications such as this, where continuous sampling and low power drain are important system requirements. A gage having the capability of continuously measuring sediment concentration over a wide concentration range (500 to 50,000 ppM of sediment averaging 2.65 g/cm^3) was designed, developed, and field tested. The gage is capable of operating and recording data unattended for a period of $7\frac{1}{2}$ days on internal power, and thus it constitutes a completely automatic monitoring station. The gage consists of a weather-proof shore-based control unit connected by 50 feet of waterproof cable to a submersible measuring head, which can be mounted on a wall or piling at any desired water depth. The head contains a sealed reference cell and a channel through which ambient water and sediment can flow. Basically, the ratio of x-ray transmission through ambient water and the reference cell containing water (but no sediment) is measured. This ratio is a function of the ratio of the densities of the two liquids, hence it is a function of the concentration of suspended sediment. This mode of self-referenced operation eliminates errors that would otherwise be present due to the decay of the radioisotope, secular drifts in x-ray detector response, temperature-induced changes in liquid density, and electronic drift. A 5-mC ^{109}Cd source supplies monoenergetic, electron-capture x rays. Ten of these sediment gages are undergoing field tests. Satisfactory preliminary test results were obtained and are presented. (auth)

Meteorology

See also Site Survey and Selection

23281 NUCLEATION AND THE WET REMOVAL OF FALLOUT. Hicks, B. B. (CSIRO, Melbourne). J. Appl. Meteorol., 5: 169-74(Apr. 1966).

The theory of condensation nucleation applied to radioactive fallout constituents showed that most tropospheric fallout particles are efficient nuclei in the production of warm rain. As a result it was found that the concentration of fallout in precipitation is a maximum soon after the onset of rain. This was supported by measurements made during many individual storms over an extensive period. The influence on fallout concentration of variations in rainfall rate through a storm was found to be complicated by the opposing effects of liquid water content of the cloud and the generation of downdrafts within it. (auth)

23282 EFFECT OF COMPLEX METEOROLOGICAL ELEMENTS ON THE NATURAL RADIOACTIVE BACKGROUND OF AIR LAYERS NEAR THE GROUND. Styro, B. I.; Nedvetskaite, T. N. Lietuvos TSR Mokslu Akad. Darbai, Ser. B, No. 4, 199 212(1965). (In Russian).

On the basis of three years measurement (1962 to 1964) of the natural radioactivity of air in the towns of Vilnius and Kaunas, the dependence of the concentration of radioactive materials on the atmosphere in complex meteorological elements was established. For anti-cyclone weather in summer and autumn and cyclone weather in summer a bond was established between the radioactivity of the air layers near the ground and the vertical gradients of the temperature up to 100 meters in the atmospheric layer. The variations from the regularity found make it possible to evaluate the effects of advection on the level of natural activity of air near the ground. It is shown that the sharpness of atmospheric fronts is connected with the fluctuations of concentration of radioactive materials. There is shown to be a relation between the climatic types of weather and the radioactivity and amplitude of the radioactivity. It is shown that during the passage of clouds of hot radioactive particles the regularities established are disturbed. (tr-auth)

Natural Radioactivity and Fallout

See also HEALTH AND SAFETY

Refer also to abstract 23392.

23283 (BNWL-SA-556) CONCENTRATION AND RETENTION OF FALLOUT RADIONUCLIDES IN ALASKAN

ARCTIC ECOSYSTEMS. Hanson, W. C.; Watson, D. G.; Perkins, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 24, 1966. Contract AT(45-1)-1830. 31p. (CONF-660405-3). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Symposium on Radioecological Concentration Processes, Stockholm.

Studies on the rates of fallout radionuclides and the cycling of fission products in northern Alaskan ecosystems were carried out in 1964 and 1965. Results are reported from measurements of 16 fallout radionuclides, including ^{110}Ag, ^{134}Cs, ^{137}Cs, ^{22}Na, ^{54}Mn, ^{60}Co, ^{65}Zn, ^{88}Y, ^{95}Zr, ^{95}Nb, ^{106}Ru, ^{125}Sb, ^{144}Ce, ^{226}Ra, ^{228}Th, and ^{55}Fe, in various ecological components by multidimensional and conventional γ spectrometry and ^{90}Sr analysis, with emphasis on the lichen-caribou-man food chain; retention of ^{85}Sr and ^{134}Cs applied to natural lichen communities; and the ^{137}Cs body burdens of Anaktuvuk Pass residents removed from a caribou meat diet for 4 weeks. Seasonal reductions of fallout radionuclide concentrations usually coincided with snow cover that prevented fallout deposition on most lichen species. Cesium-137 concentrations increased by a factor of about two in successive trophic levels of the lichen-caribou-wolf food chain. Strontium-85 applied to lichens was more mobile than was ^{134}Cs similarly applied. Biological half-times for these two radionuclides were 280 and 1300 days, respectively. Strontium-90 content in lichens was about the same as that of ^{54}Mn and ^{90}Sr behaved similarly in response to environmental factors. The ingestion of ^{90}Sr via caribou meat by Anaktuvuk Pass adult Eskimos during the summers of 1961 through 1965 was generally less than 20 pCi/day and decreased by 30% when fall-killed animals were utilized. Preliminary results of ^{137}Cs half-time studies in Eskimos on modified diets showed a consistent relation of half-time to age and weight. (27 references.) (C.H.)

23284 (CEA-R-2886) CONTRIBUTION A L'ETUDE DU COMPORTEMENT GEOPHYSIQUE DU PLOMB 210 PAR APPLICATION DE LA SPECTROMETRIE ALPHA [THESES]. (Contribution to the Study of the Geophysical Behavior of ^{210}Pb by Application of Alpha Spectrometry [Thesis]). Nezami, Mehdi (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1966. 95p. Dep. mn.

Submitted to Paris Univ., France.

A study of the changes in the lead-210 contents of rainwater and of water produced by melting polar ice required the development of a method for dosing lead-210, an α emitter. The method is 40 times more sensitive than measuring the lead-210 by bismuth-210, a β emitter. The study of α spectrometry using semiconductor detectors is discussed along with advantages of the method. A new chemical separation method for polonium-210 and the results obtained are described. The results showed that the monthly lead-210 and polonium-210 contents in rainwater are approximately constant with time. In the Gif-sur-Yvette region, the clean-up by dry fallout can attain 40 to 50% of the total fallout. A study of Antarctic ice samples made it possible to determine an annual accumulation rate equivalent to 13.8 cms of water and to show discrepancies in the periodic concentrations that correspond to the latest maxima of solar activity. A balance was drawn up between the radon produced by the continents and the lead-210 fallout. (auth)

23285 (HNS-58) RADIOACTIVE FALLOUT FROM TWO SEVERE STORMS IN OKLAHOMA DURING MAY 1963. Progress Report. Booker, D. Ray; Hamada, Gerald; Kruger, Paul (Hazleton-Nuclear Science Corp., Palo Alto, Calif. Radiochemistry Dept.). Dec. 31, 1964. Contract AT(04-3)-457. 55p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

A radiochemical and meteorological study of two severe storms in Oklahoma during May, 1963, both of which are believed to have penetrated into the stratosphere, revealed an apparent lack of high-level nuclear debris in the ground-level precipitation. The data from these two storms are compared to corresponding data from contemporary convective storms in Pennsylvania, none of the latter having penetrated through the tropopause. The marked similarity in ^{90}Sr concentrations in precipitation indicates that the precipitation reaching the ground from the severe storms were of about the same altitude-origin as the convective showers and may be indicative of the role of entrainment as a function of convective severity. This observation is supported by examining differences by location in the May 26 severe storm in Oklahoma. Samples from the site where a greater degree of cell isolation was evident contained greater ^{90}Sr concentrations than another site where the storm was more organized with, concomitantly, lesser entrainment of dry environmental air. The effects of cell edge evaporation extent and of hail vs. water precipitation were also noted. (auth)

23286 (UCRL-14702) DEPOSITION VELOCITIES OF AEROSOLS AND VAPORS ON PASTURE GRASS. Fisher, H. Leonard (Lawrence Radiation Lab., Univ. of California, Livermore). Mar. 14, 1966. Contract W-7405-eng-48. 20p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Predictive models of vapor and aerosol particle deposition velocities on grass surfaces are presented both as equations and as parametric curves that illustrate the relationship between the deposition velocity and such factors as wind speed, terrain roughness, and the terminal velocity of particles. Comparison is made with experimental results under known conditions and it is demonstrated that vapor deposition velocity can be predicted to within a factor of 3, while particle deposition velocity can be predicted to a factor of 2 or better, the accuracy increasing with increasing particle size. The deposition velocity of fallout debris was calculated both for deposition on pasture grass and fallout collectors (pot or gummed-film) at wind speeds on the order of 10 mph. These calculations indicate that the deposition velocity on pasture grass for vapors and small particles is approximately three times as great as the deposition velocity on the fallout collectors. For particles 20 microns in diameter, the calculated values are the same for both types of surfaces. (auth)

23287 SEPARATION OF PROMETHIUM FROM A NATURAL LANTHANON MIXTURE. Eraemetsae, Olavi Acta Polytech. Scand., Chem. Met. Ser., No. 37, 1-21 (1965).

The history of the search for Pm in natural lanthanide mixtures is traced. A process is described by which it was possible to separate a Pm fraction, which gave an activity corresponding to 310 cpm for an 82-g sample. Absorption measurements showed it to be β activity with a maximum energy of 210 kev. From 6,000,000 kg of apatite, 20,000 kg of lanthanide oxides were separated. After repeated fractionation by ion-exchange resins, an 82-mg fraction between neodymium and samarium was obtained and radioactivity measurements indicated a total amount of 0.9×10^{-11} g of ^{147}Pm in this fraction. The ^{147}Pm was likely produced from ^{146}Nd by natural neutron radiation. It is not likely that all the promethium arose as a fission product. Calculations showed that the cosmic radiation bombarding ^{146}Nd would suffice to produce the observed activity of ^{147}Pm, even considering the losses in the process of concentration. Part of the ^{147}Pm may have come from the α decay of ^{151}Eu. Investigations with x-ray fluorescence spectrography and optical spectrography pointed toward the presence of a much larger amount of some long-lived isotope of promethium. The observed effects were so weak that the treatment of an amount of raw material ten times larger than the previous sample was required. The concentration of a long-lived promethium isotope in apatite did not exceed 10^{-10}%. (BBB)

23288 ABILITY OF DIFFERENT TYPES OF PRECIPITATION TO WASH OUT FISSION PRODUCTS FROM THE ATMOSPHERE. Makhon'ko, K. P.; Dmitrieva, G. V. Fiz. Atmos. Okeana, 2: 297-304(Mar. 1966). (In Russian).

Analysis of IGY-IGC data suggests that mist and drizzle are the least efficient precipitants in respect to washout. Washout rates of fission products were reported to be 0.9 km/day. Washout characteristics are compared for various geographical regions. (TCO)

23289 RADIOACTIVITY OF THE UNDERGROUND WATERS IN WEST-UKRAINIAN REGION. Mal'skaya, R. V. (Lvov Oil and Gas Prospecting Trust). Geokhimiya, No. 12, 1487-90(Dec. 1965). (In Russian).

The natural background of uranium and radium, and anomalies in the concentration of these elements in underground waters of the Western Ukraine were determined. The natural uranium background was found to be 3.25 to 6.5×10^{-7} g/dm^3 independent of origin. The background radium content increased regularly with increasing secondary deposition and with increasing water depth. An analysis of the data showed that positive radium anomalies which were not associated with hydrocarbon deposits were due to a high radium content in the rocks. An increased radium content (both relative and absolute) was observed in waters associated with gas deposits in the Outer Zone of the precarpathian depression. Only a background radium content was noted in the Inner Zone. Hence, an increased radium content in waters of the Outer Zone is believed to be a positive criterion of the presence of gas. In this case the absolute radium content was >2 to 5×10^{-11} g/dm^3, and the relative radium content was a factor of 2.0 to 2.5 greater than the natural background after correcting for the mineral content of the water. (TTT)

23290 ATMOSPHERIC ^{222}Rn CONCENTRATION VARIATION WITH HEIGHT AND TIME. Pearson, John E.; Moses, Harry (Argonne National Lab., Ill.). J. Appl. Meteorol., 5: 175-81(Apr. 1966).

Studies of concentrations of ^{222}Rn in the atmosphere were made from the surface of the earth to 16 meters elevation for eight periods of approximately 24 hours each. These studies provide over 650 individual determinations of radon concentration measured during a wide variety of meteorological conditions, from clear days with high radiation and relatively weak winds to cloudy days of low radiation and relatively high winds. Information presented indicates some general features of radon concentration: highest concentrations near the soil, the source; maximum concentrations at night with the maximum near the soil occurring about 3 hours before the maximum at 16 meters; minimum values at all levels near midday; almost constant concentration with elevation, indicating good mixing during morning hours; and increases in concentration at ground level ahead of those aloft with the approach of evening. The average 24-hour exposure at human breathing level, between 1 and 4 meters, varies between 0.259 and 0.301 picocuries per liter at the Argonne National Laboratory site. (auth)

23291 THE GLOBAL ^{90}Sr BUDGET. Volchok, H. L. (U. S. Atomic Energy Commission, New York). J. Geophys. Res., 71: 1515-18(Mar. 15, 1966).

Inventories of ^{90}Sr in the earth's environment were made for a series of dates between August 1961 and March 1965. On every date tested these inventories are found to be deficient when compared with the amount of ^{90}Sr expected to be present, on the basis of nuclear weapons tests conducted in the atmosphere. The major portion of this deficiency is attributed to a 33% error in the inventory of ^{90}Sr deposited on the earth's surface that is caused by assuming that the observed fallout on land is equivalent to that on the oceans, per unit area. It is suggested that water bodies collect fallout 1.5 times more efficiently than land. Applying this factor to the worldwide ^{90}Sr deposition inventory results in good agreement between stratospheric depletion and worldwide deposition, in addition to accounting for the apparent budget deficiency. (auth)

23292 DISEQUILIBRIUM BETWEEN THE SHORT-LIVED RADON DAUGHTER PRODUCTS IN THE LOWER ATMOSPHERE RESULTING FROM THEIR WASHOUT BY RAIN. Gat, J. R.; Assaf, G.; Miko, A. (Weizmann Inst. of Science, Rehovoth, Israel). J. Geophys. Res., 71: 1525-35(Mar. 15, 1966).

The concentration changes of the short-lived daughter products of ^{222}Rn in air due to washout were computed according to a three-phase (gas-aerosol-raindrop) model for a wide range of values of the system parameters. It is shown that the ratio of ^{214}Pb to ^{214}Bi concentrations is a sensitive measure of the relative washout efficiences of free atoms and of aerosol particles by rain. Preliminary experimental results which give the measured values of this ratio for rainy days are presented. (auth)

23293 ISOTOPIC COMPOSITION OF LEAD IN VOLCANIC ROCKS FROM HAWAII, IWO JIMA, AND JAPAN. Tatsumoto, M. (Geological Survey, Denver). J. Geophys. Res., 71: 1721-33(Mar. 15, 1966).

The isotopic compositions of lead and abundances of uranium, thorium, and lead in volcanic rocks from Hawaii, Iwo Jima, and Japan were determined. Lead from Hawaii and Japan lies close to the "geochron" (primary isochron of zero age for the earth), but that from Iwo Jima shows a large radiogenic lead aberration. Leads from Hawaii fit a $\mu_0 = 8.65$ primary growth curve and those from Japan a $\mu_0 = 8.75$ primary growth curve. This difference suggests that the characteristics of continent and ocean were established early in the history of the earth. The isotopic compositions of lead indicate that the source region of basalt (probably upper mantle) has not remained in a closed system and that the upper mantle is heterogeneous in chemical composition. The discrepancy between the measured μ, k, and the value expected from the isotopic composition of lead suggests that multiple differentiation occurred in the source region of basalts or that sources of lead, uranium, and thorium are not the same by a different degree of partial melting of the heterogeneous upper mantle. (auth)

23294 RADIOACTIVE DEBRIS OVER FAIRBANKS, ALASKA, ON FEBRUARY 18, 1965. Wong, Yam Suen (Univ. of Alaska, College). J. Geophys. Res., 71: 1766-7 (Mar. 15, 1966).

Radioactive debris was observed in the lower atmosphere over Fairbanks, Alaska (65°N, 148°W), on February 18, 1965, during a balloon flight. The balloon-borne detector, a Victoreen 1B, 1965, Geiger counter shielded by $\frac{1}{32}$ inch of lead with a narrow slit opening, recorded counting rates estimated to be over three times that from normal cosmic background radiations. The debris appeared to lie in two or more layers. One layer extended vertically from 6 to 8 km in association with a layer of maximum wind speed. Above 8 km the counting rate was irregular but always higher than the normal rates measured on previous flights. A plot is given of the counting rates versus the geometric altitude. (J.F.P.)

23295 A TEST FOR EXCESS RADIOGENIC ARGON IN MICAS. Hart, S. R. (Carnegie Institution of Washington, D. C.). J. Geophys. Res., 71: 1769-70(Mar. 15, 1966).

An extension is made of a previous test on margarite for excess argon in micas. It is concluded that under the environmental conditions similar to those under which the minerals studied were formed, samples of which were taken from Emory, Massachusetts, the amount of excess radiogenic argon incorporated in micas is less than 2 to 7 $(10)^{-8}$ cm^3/g. In a potassium mica this would cause a maximum error in age of 0.2 m.y., which is insignificant for most dating purposes. (J.F.P.)

23296 SOME OBSERVATIONS ON RADON IN WATERS AND ITS REMOVAL BY AERATION. Hoather, Roy C.; Rackham, R. F. (Counties Public Health Labs., London). J. Inst. Water Eng., 17: 13-22(Feb. 1963).

Five samples of ground water were analyzed for radium, radon, radium D, the total content of saline constituents, and potassium. The radon content of the water (2.7 to 15 μC/l) was sufficiently high to require its removal. The treatment already planned for the water was aeration, by an adjustable bellmouth, to remove one-half of the free carbon dioxide, so that the other half could be neutralized with lime, and a sufficient amount of calcium carbonate alkalinity thereby be introduced to correct its corrosive characteristics. Aeration regulated in this manner was unlikely to reduce the radon content of the

water sufficiently from its natural figure of 15 μC/l. To investigate this, lab experiments were carried out using a sintered glass disk from which air was made to rise through the water in small bubbles. The depth of water was ~ 3 in. Partial removal (~75%, after 4 hr) was obtained with an air/water ratio of 2/1. A delay of about 4 hr before counting the treated water allowed time for the decay of the daughter products radium B and C, because aeration removes only the radon gas. For plant design it was necessary to envisage a higher ratio of air, but with arrangements for the amount of air to be reduced for economy if the results proved such reduction to be satisfactory. If circumstances permit storage of the water for a sufficient length of time for radioactive decay, depending on the radon content and the half life of 3.8 days, treatment by aeration would be unnecessary. If the air were frequently to stagnate around the aeration works it appears that any population in the area considered would be likely to be exposed to a long-term hazard. For any very large-scale aeration treatment, the plant should, therefore, be situated in an isolated position. (BBB)

23297 SEASONAL VARIATION OF THE RADIOACTIVE FALLOUT. Murayama, N. Kishocho Kenkyu Jiho, 17: 32-8(Dec. 1965). (In Japanese).

Seasonal variation in ^{90}Sr fallout in Japan in 1963 and 1964 is discussed. The fallout maximum and minimum appear with lags of 10-degree latitude per month from about 20° lat to about 60° lat. Tritium concentration in Tokyo precipitation showed a seasonal trend. (auth)

23298 PUBLIC ASPECTS OF ^{137}Cs IN RUMINANTS. Shannon, R. O.; McClellan, R. O.; Watson, C. R.; Bustad, L. K. (Battelle Memorial Inst., Richland, Wash.). J. Amer. Vet. Med. Ass., 147: 1488-91(Dec. 15, 1965). (BNWL-SA-282(Rev.)).

Measurements of radioactive fallout in the Richland, Wash., environs and dietary studies of the local population are being conducted. In 1964, it was estimated that the average Richland adult received 40% of dietary ^{137}Cs from meat and 35% from milk, whereas the average year-old child received 30% from meat and 60% from milk. Present ^{137}Cs levels in meat and milk are not a hazard to human health. Milk produced in the Richland area in 1964 averaged 70 pC ^{137}Cs/l. This level is attributable to fallout from past weapons tests and is little influenced by the proximity of the Atomic Energy Commission's plutonium production operations. (BBB)

23299 PREDICTION OF FUTURE LEVELS OF LONG-LIVED FISSION PRODUCTS IN MILK. Bartlett, B. O.; Russell, R. Scott (Argricultural Research Council Radiobiological Lab., Wantage, Eng.). Nature, 209: 1062-5(Mar. 12, 1966).

Data on the content of ^{137}Cs and ^{90}Sr in milk in the United Kingdom from 1957 through 1964 indicate that the annual average level is influenced to an appreciable extent by the rate of fallout in the last half of the previous year as well as by the current rate of fallout and cumulative deposit. The average ratio of ^{137}Cs to ^{90}Sr in fallout is relatively constant and the deposition of ^{137}Cs can be calculated from that of ^{90}Sr taking the ratio of ^{137}Cs to ^{90}Sr as 1 to 7 up to 1961 and 1 to 5 since then. These two nuclides are mainly responsible for the internal radiation dose and their content in milk provides a good guide for the exposure of children and also that of adults on a mixed diet typical in Western countries. An improved equation is presented for predicting future levels of ^{137}Cs and ^{90}Sr in milk that reflects a reduced soil factor for ^{90}Sr and a small soil factor for ^{137}Cs that would result in a higher ratio of ^{137}Cs in milk over a 50-yr period. The effects of climate, soil type, and agricultural practices on the results of long-term predictions of radioactivity due to long-lived fission products are discussed. (C.H.)

23300 ^{54}Mn: FRACTIONAL DISTRIBUTION IN WHEAT AND OCCURRENCE IN OTHER FOODS. Sutton, Doris C.; Kelly, John J. (Atomic Energy Commission, New York). Nature, 209: 1081-3(Mar. 12, 1966).

Manganese-54, a neutron activation product, was detected in fallout in 1956. Stable Mn is present in the soil and in many parts of plants and several organs of animals and humans. The availability of Mn to plants is dependent on the chemical form, soil type, soil chemistry, and other environmental factors. Results are reported from measurements on the ^{54}Mn and stable Mn content in wheat samples from eleven states in the U. S. during 1963. The distribution of ^{54}Mn in a wheat sample separated into its milling fractions was also measured. Results indicated that uptake of ^{54}Mn is through the roots of plants and that a rapid exchange occurs between natural Mn and ^{54}Mn. The content of ^{54}Mn was determined in 10 selected food samples in New York City in May 1964 in order to estimate the ^{54}Mn content in the 1964 diet. Results showed the amounts of ^{54}Mn and stable Mn in whole wheat bread were approximately 10 times higher than the amounts found in white bread. This gave good agreement with results of measurements on wheat fractions and further substantiates the exchange between ^{54}Mn and stable Mn. Small amounts of ^{54}Mn were detected in fresh fruits and fresh vegetables, but none was detected in root vegetables or in rice. The amount in dry beans was almost equal to the amount in white flour. As a result of the measurements, an intake of about 160 pc ^{54}Mn/week was postulated for the general population in 1964. This amount is not considered a health hazard. (C.H.)

23301 REGIONAL DISTRIBUTION OF ^{90}Sr ON THE SURFACE OF THE WORLD OCEAN. Patin, S. A. Okeanologiya, 5: 458-62(1965).

A study on the distribution of ^{90}Sr on the surfaces of the Atlantic, Pacific, and Indian Oceans was combined with previous data for purposes of comparison. Calculations of atmospheric fallout of ^{90}Sr on oceanic surfaces show that the fallout in the northern Atlantic and Pacific is three times that in the southern parts of these oceans. The ratio of ^{90}Sr in the surface waters of the Atlantic and Pacific Oceans was essentially the same as that of the total fallout on the oceans. The amount of ^{90}Sr in the surface waters of the Indian Ocean was much greater than anticipated from global fallout. The average time ^{90}Sr remains in the surface layers of the Atlantic and Pacific was less than 3.5 years. The effects of the horizontal motion of water in the surface layers on the geographical distribution of ^{90}Sr during global fallout caused some smoothing of ^{90}Sr extremums in oceanic surfaces but did not destroy the general distribution trend, and if no further contamination takes place, one-half of the ^{90}Sr should be eliminated from the surface layers of the oceans approximately every two years. (CFSTI)

23302 OCEANS AND THE PROBLEM OF ARTIFICIAL RADIOACTIVITY. Schreiber, B. (Univ., Parma, Italy). Scientia (Milan), 100: 158-64(July-Aug. 1965). (In Italian).

The study of protection methods from nuclear fission products and contamination from radioactive industrial wastes have given new impetus to oceanography. In turn, renewed interest in marine problems focused scientific interest on studies of currents, vertical movement, geochemical equilibria, and radioisotope accumulation and circulation in biological systems. (H.G.D.)

23303 SUM-COINCIDENCE GAMMA-RAY SPECTROMETRY IN TRACING ^{60}Co AND ^{110m}Ag IN MARINE ORGANISMS. Folsom, T. R.; Young, D. R.; Finnin, L. E. (Scripps Institution of Oceanography, La Jolla, Calif.). pp 57-69 of STI-PUB-106.

Traces of ^{60}Co were evident in conventional gamma-ray spectra from selected marine organisms collected in the Pacific Ocean in 1963 and 1964. To extend the survey of this biologically significant nuclide, a special spectrometer was set up providing for large samples, and using circuitry especially effective for discrimination of ^{60}Co photons from other gamma-ray signals that are now common in marine biological specimens. Two sodium iodide scintillators 20 cm in diameter and 10-cm thick were spaced 2.5 cm apart and the specimens were exposed between these in a plastic

box 11 cm in diameter and 2-cm thick. The circuitry preferred for ^{60}Co included the summation of pulses from the two crystals with the restriction also that only coincident events are counted and only when one of the crystals totally converts a photon having energy of 1.1 ± 0.1 Mev. This presents much of the ^{60}Co cascade as a sum peak lying beyond the ^{40}K peak, completely away from its interference and where the instrument background is relatively low. Other environmental nuclides such as ^{106}Ru and the radium and thorium families are effectively excluded. For example, the 2.5 Mev sum peak of ^{60}Co in a typical spectrum of Mytilus tissue was shown to include radium interference of about 4%; thorium interference of about 0.1%; and ^{106}Ru interference of about 3%. Stable counting for 16 to 36 hr was carried out and analyses of specimens containing about 10 pCi of ^{60}Co were replicated with a standard error of about 10%. Specimens weighing more than 1 kg (wet) can be analyzed by drying or ashing. With this equipment it was possible to compare in a short time the ^{60}Co in tissues from the Pacific, Atlantic, and Indian Oceans. Highest concentrations generally appeared in liver tissue, and the geographical distribution reflected many oceanographic and meteorological factors known to influence fallout. Spectra from this survey often disclosed a sum peak at 2.93 Mev, and this brought to light the wide-spread presence of ^{110m}Ag in the oceans. (auth)

23304 COMPARATIVE STUDY OF THE METHODS USED FOR THE COMPUTER RESOLUTION OF COMPOSITE GAMMA-RAY SPECTRA. DeHaan, A. Jr.; Leventhal, L.; Benson, P. (Tracerlab, Richmond, Calif.). pp 169-85 of STI-PUB-106.

The resolution of complex mixtures of gamma-ray emitters has been expedited by the use of highly sophisticated gamma-ray spectrometers in association with digital computers. These instruments have now become generally available or easily accessible to technical laboratories. A technique is described that was used to obtain the concentrations of individual gamma-emitting radionuclides in fallout samples and compares the results obtained by the various mathematical methods on composite samples. The computer derived data are compared with results obtained by radiochemical analysis of the sample. Binary mixtures were analyzed by methods outlined below and then the analysis was extended to the many component system. A computer method was developed which normalizes gamma-ray spectra to minimize the effect of long-term spectrometer drift and converts the spectrum to an energy co-ordinate system. The effects of an unexpected, zero intensity component, and overlapping peaks on the solution by the various methods were investigated with special emphasis on low-level samples. The most common mathematical methods for resolving a composite gamma-ray spectrum into its components were investigated. Most of these procedures lead to estimates for the concentrations of the different gamma-ray emitters by one of the following methods: (1) The successive elimination of the radionuclides with higher energy photopeaks subtracting the pure spectrum from the composite spectrum until it has been resolved; (2) Peak resolution without stripping; (3) The establishment of a set of simultaneous linear equations of the same order as the number of radionuclides in the mixture and its solution; (4) The estimation of the unknown concentrations by the method of least-squares, either conventional or weighted; or (5) A combined statistical and least-squares method employing stepwise multiple linear regression, an attempt to integrate decision-making process into the analysis. Statistical estimates for the errors in the resulting concentration of the radionuclides are provided for each analytical method when they are applied to multicomponent radionuclide mixtures. (auth)

23305 ASSAY OF SMALL TRACES OF ^{137}Cs BY INTERNAL CONVERSION ELECTRONS. Folsom, T. R.; Pillai, K. C.; Finnin, L. E. (Scripps Institution of Oceanography, La Jolla, Calif.). pp 699-706 of STI-PUB-106.

A method is described for determining fallout ^{137}Cs in relatively small volumes of seawater through the pulse-height spectrum of the internal conversion electrons (ICE) acting upon silicon detectors. In sea samples of convenient size (20 l) there are only small amounts of activity (0.05 to 10.0 pCi) therefore high counting efficiency and low background in the detector must be emphasized rather than exquisite peak resolution. Fortunately, the ICE peak of ^{137}Cs is easily distinguished from the betas of K and Rb (and certain other nuclides) whose effects are otherwise difficult to avoid or control by chemical means alone. A somewhat simplified analytical procedure results in a very thin counting specimen that is placed between two closely spaced (3 mm) lithium-drifted silicon detectors (25 mm diameter, 2 mm thick). About 50% of the ICE are put into the spectral peak; about 10% of all ^{137}Cs disintegrations result in ICE. However, background under the spectral peak is very low (now about 0.05 cpm for a pair of detectors). Present resolutions (at room temperature and under conditions providing high efficiency) are about 60 kev but it is likely that both the background and the resolution will be improved. Long counting times (1000 to 3000 min) are offset by the possibility of using four detectors per pulse analyzer. (auth)

23306 BULLETIN OF THE ATMOSPHERIC RADIOACTIVITY, NO. 39, OCTOBER-DECEMBER, 1964. Taiki Hoshano Kansoku Seiseki, No. 39, 1-83(Oct.-Dec. 1964).

Data are tabulated on the content of fallout radioactivity in the atmosphere and in precipitation in Japan during the last three months of 1964. (C.H.)

23307 METEOROLOGICAL ASPECTS OF ATMOSPHERIC RADIOACTIVITY. WMO-No. 169, TP. 83. Bleeker, W. (ed.). WMO (World Meteorol. Organ.), Tech. Note No. 68, 1-194(1965). (CONF-641027).

Separate abstracts have been prepared for all ten papers presented during the thirteenth session of the United Nations Scientific Committee on the Effects of Atomic Radiation in Geneva in 1964. (A.G.W.)

For abstracts of individual papers see: 23279, 23308–23315, and 23328.

23308 PARTICLE FORMATION IN NUCLEAR BOMB DEBRIS. Storeboe, P. B. WMO (World Meteorol. Organ.), Tech. Note No. 68, 1-26(1965).

An attempt to calculate particle sizes in nuclear explosions when only vaporized substances are present begins with a macroscopic description of the explosion development and computation of variations of relative mass, relative volume, and mean temperature of the fireball and the rising particle cloud. Condensation within the ball of fire, agglomeration of particles, water vapor condensation, and influences of natural conditions on particles are then considered. Results are only approximate, but it is concluded that the particles formed by the condensation of vapor are considerably greater than the size of a spontaneously formed condensation nucleus. Agglomeration during the rise of the particle cloud and after stabilization in the possible water cloud formed tends to set a lower limit to the particle size. Indications are that the ultimate size of the particles released in the stratosphere is great enough for the vertical transport due to gravity to be important in comparison with spreading due to air exchange. (A.G.W.)

23309 SOME COMMENTS ON METEOROLOGICAL PROBLEMS OF THE GLOBAL DISTRIBUTION OF STRATOSPHERIC RADIOACTIVE FALLOUT. Karol, L. WMO (World Meteorol. Organ.), Tech. Note No. 68, 57-67(1965).

Studies of meteorological factors affecting the global distribution of the radioactive products of nuclear explosions are reviewed, gaps in present knowledge are pointed out, and possible lines of research are indicated. Some data are presented on distribution of radioisotopes in the troposphere and stratosphere, and conclusions concerning mechanisms of transport and distribution are discussed. Other areas in which further study is suggested include physico-chemical properties of radioactive aerosols and mechanisms of dry deposition of aerosols on the earth's surface. (A.G.W.)

23310 SOME REMARKS ABOUT THE SCAVENGING OF RADIOACTIVE MATERIAL FROM THE ATMOSPHERE BY

PRECIPITATION. Bleeker, W.; Lablans, W. N. WMO (World Meteorol. Organ.), Tech. Note No. 68, 95-116(1965).

The formation of cloud and precipitation elements and the processes through which radioactive particles could be enclosed in precipitation elements are reviewed. Results of some studies of change of radioactivity in precipitation with time in showers and in layered cloud systems are presented. Mechanisms that might possibly account for these changes are discussed. (A.G.W.)

23311 VERTICAL TRANSPORTS AND DEPOSITIONS OF ATMOSPHERIC CONSTITUENTS. Eriksson, E. WMO (World Meteorol. Organ.), Tech. Note No. 68, 117-22 (1965).

Two mechanisms for vertical transport of matter in the atmosphere are reviewed briefly: eddy diffusion and fall due to gravity. Deposition processes and processes whereby matter in small particles is transferred to larger particles are considered. It is concluded that cloud formation is the most important process for transferring radioactive debris to large particles that can be expected to fall out within a reasonable time. Over land suspended soil matter may be important as a scavenger. (A.G.W.)

23312 RADIOACTIVE CONTAMINATION OF THE OCEANS. Suschny, O. WMO (World Meteorol. Organ.), Tech. Note No. 68, 123-46(1965).

Average levels of radioactivity and sedimentation, transportation, and accumulation of radioisotopes in the oceans are reviewed. Three main sources of radioactivity in the oceans are primordial radioisotopes, cosmic-ray produced radioisotopes, and artificial radioisotopes (from nuclear explosions and waste disposal). Chemical factors, water movement, and biological processes affect the distribution of radioisotopes. It is concluded that most of the radioactivity in the oceans is of natural origin. Of that part contributed by man, the predominant share comes from nuclear weapon tests. The contribution from waste disposal is insignificant on a world-wide scale, but more research on mixing is needed to assure that no local problems result. (151 references) (A.G.W.)

23313 FALLOUT FORECASTING. Machta, L. WMO (World Meteorol. Organ.), Tech. Note No. 68, 147-53(1965).

Methods and techniques of fallout forecasting are reviewed. Annual fallout rates from lower equatorial nuclear tests during the spring and summer of 1958 and the Arctic test series of autumn 1958 are summarized. The basis for 1963 fallout prediction in the United States is discussed. It is concluded that, although agreement of 1963 predictions with measurements was good, better understanding of atmospheric transport and diffusion is still needed. (A.G.W.)

23314 SOME ASPECTS OF THE U.S.A. FALLOUT PROGRAMME. Machta, L. WMO (World Meteorol. Organ.), Tech. Note No. 68, 155-77(1965).

Unrelated subjects of interest to meteorologists and scientists reviewed include the following: inventories of Sr-90 and C-14 in the stratosphere and troposphere from 1960 to 1963, artificial production of certain radioisotopes (Be-7, Pb-210, Cd-109, Mn-54, and Sr-90), use of radioactivity as a tracer in a study of air transfer from the stratosphere to the troposphere, a quantitative comparison of five processes involved in stratosphere to troposphere exchange, and mesoscale variation in Sr-90 deposition and rainwater concentrations (results for two storms in Illinois in July 1962). (A.G.W.)

23315 SOME REMARKS WITH RESPECT TO THE HIGH RADIOACTIVITY IN WESTERN EUROPE DURING NOVEMBER 1962. Lablans, W. N.; Bleeker, W. WMO (World Meteorol. Organ.), Tech. Note No. 68, 178-94(1965).

Diagrams show the development of an area of very high gross radioactivity over western Europe during the period Nov. 5 to Nov. 13, 1962. Meteorological conditions in the area at the time were studied, and air flow patterns at 850 and 300 mb for the period are shown. It is concluded that it is most probable that the radioactive material came from an intermediate-yield test on Oct. 29, 1962, near Novaya Zemlya. The usefulness of total β-activity measurements is pointed out. (A.G.W.)

Techniques and Equipment

23316 (AD-625199) EXPLORATORY MEETING ON THE MAGNETIC TAPE RECORDING OF SEISMIC DATA. Aein, Joseph M. (Institute for Defense Analyses, Washington, D. C. Research and Engineering Support Div.). Sept. 1965. Contract SD-50. 27p. (IDA-HQ-65-4151). CFSTI $2.00 cy, $0.50 mn.

The problems of obtaining magnetic tape records of seismic data over a relatively wide bandwidth (up to 10 cps) with large dynamic range are reviewed, and current seismic tape recording capabilities are surveyed. (auth)

23317 (AD-627373) STUDIES OF THE EFFECT OF DEPTH OF FOCUS ON SEISMIC PULSES. Annual Report. 1965. Howell, B. F. Jr.; Lavin, P. M. (Pennsylvania State Univ., University Park. Dept. of Geology and Geophysics). Contract AF19(628)-238. 42p. CFSTI $2.00 cy, $0.50 mn.

An investigation was made to improve the accuracy of focal-depth determination as a means of distinguishing between natural earthquakes and explosions. The research consisted mainly of evaluating a method of focal-depth determination which depends on recognition of the sequence of events which arise from the reflection of the initial P pulse at the surface, and evaluating the factors controlling the accuracy of this measurement. The effect of the nature of a boundary on seismic pulses refracted along it both in scale models and in the real earth was investigated. (auth)

23318 (AD-631043) CHARCOAL. Long Range Seismic Measurements [of] VELA UNIFORM. Seismic Data Laboratory Report No. 138. Clark, Don M. (UED Earth Sciences Div., Teledyne, Inc., Alexandria, Va.). Sept. 10, 1965. Contract AF 33(657)-15919. 25p. CFSTI $2.00 cy, $0.50 mn.

An analysis of seismological data from an underground nuclear explosion as a continuing study to provide information to aid in distinguishing between earthquakes and explosions is given. A table of travel-times and amplitudes of P, Pg, Lg, and surface waves are included along with other unidentified phases. (auth)

23319 (AD-631052) CHASE IV. Long Range Seismic Measurements [of] VELA UNIFORM. Seismic Data Laboratory Report No. 137. Clark, Don M. (UED Earth Sciences Div., Teledyne, Inc., Alexandria, Va.). Sept. 16, 1965. Contract AF 33(657)-12447. 21p. CFSTI $1.00 cy, $0.50 mn.

An analysis is given of an underwater HE shot as a continuing study to provide information to aid in distinguishing between earthquakes and explosions. A table of travel times and amplitudes of identified as well as unidentified phases is included. (auth)

23320 (CONF-640413, pp 107-11) LE TRITIUM UTILISE COMME TRACEUR EN GEOPHYSIQUE. (Tritium Used as a Tracer in Geophysics). Slizewicz, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

In a review of the uses of tritium in the study of geophysical phenomena, the different methods for the determination of tritium are first described. Some examples are then given of the possibilities of the use of tritium either for the study of marine currents or for the improved knowledge of the circulation of surface or subterranean waters. (tr-auth)

23321 (ORO-597) SELECTED TOPICS ON WATER TRACING WITH RADIOISOTOPES. Development of Engineering Techniques for Isotopic Water Tracing. Sample Preparation, and Radiation Measurement. Final Report. Ballard, Lewis F.; Gardner, Robin P.; Gillespie, Arthur S.; Ely, Ralph L. Jr. (Research Triangle Inst., Durham. N. C. Measurement and Controls Lab.). Nov. 19, 1964. Contract AT(40-1)-2513. 117p. (RTI-2513-T9). Dep. mn. CFSTI $4.00 cy, $0.75 mn.

The use of radioisotopes in water tracing was surveyed and presented in a manner that emphasized engineering applications. Also, some effort was made in filling some

of the gaps in water tracing techniques in the area of radiation measurement. The development of a field tritium counting technique and radio-release analysis technique using nonradioactive tracers is described as well as a considerable amount of experimental work to determine the measurement sensitivity for various emitted radiations in water. Altogether 63 references are cited. (P.C.H.)

23322 (PEL-85(Suppl.1)) APPLICATION OF RADIOISOTOPES AND RADIATION IN HYDROLOGY. A Bibliography. Rossouw, S. F. (comp.) (Atomic Energy Board, Pelindaba (South Africa)). Feb. 1966. 6p. Dep. mn.

Twelve references with abstracts are given to reports and journals published during 1964 and 1965. (P.C.H.)

23323 (UCRL-12326) CALCULATIONS OF THE SHOCK WAVE FROM A NUCLEAR EXPLOSION IN SALT: PROJECT SALMON. Rogers, Leo A. (Lawrence Radiation Lab., Univ. of California, Livermore). May 6, 1965. Contract W-7405-eng-48. 30p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Calculations (SOC Computer Code) of shock pressure, position, velocity, and material displacement were made for the Salmon detonation (design yield of 5 kt). Preshot calculations based on results from the Gnome event (3.1 kt in salt) and postshot calculations based mostly on the physical properties measurements of the material in the shot region were made. Comparison of the calculations with preliminary experimental data gives agreement for peak pressure and peak velocity within 20 to 50% over the range calculated (1–600 meters). The calculated time-of-arrival of the shock front was within 1 to 10% of the experimental data. Calculated displacements of the salt at 300 meters were within 25% of the experimental data, and ground surface motion directly above the shot was within 10 to 50% of the preliminary experimental data. The postshot calculations generally gave better agreement with the data, since several errors and difficulties in the preshot calculations were corrected. No arbitrary adjustment of code input parameters (parameter studies) was made to force the postshot calculations to agree with the experimental data. (auth)

23324 (UCRL-12328) CALCULATION OF FIRST-ZONE, P-WAVE AMPLITUDES FOR SALMON AND DISTANT DECOUPLING. Springer, Donald L. (Lawrence Radiation Lab., Univ. of California, Livermore). May 17, 1965. Contract W-7405-eng-48. 26p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Theoretical calculations of the first half-cycle amplitudes of the P-wave at 250 km to 1000 km are made from source functions representing several types of nuclear explosions in salt. Specifically, they are Gnome scaled to 5 kton; Salmon; a theoretical 25-kton detonation in a cavity built to fully decouple a 5-kton explosion; and a theoretical 5-kton detonation in a 5-kton cavity. The calculations consist of a series of convolutions of the source functions plus the attenuation operators plus the instrument response. Amplitude factors are calculated using Zvolinskii's near-front approximation for various assumed crustal models. Experimental amplitudes from Salmon fall below the amplitude curve for the scaled Gnome source. They are consistent with amplitudes for the Salmon source. Amplitudes calculated for the fully decoupled 5-kton source show a decoupling of 200. Those from the overdriven cavity source indicate a partial decoupling of 80 can be gained by overdriving a fully decoupling cavity by a factor of 5. (auth)

23325 CURRENT STATUS OF RADIOACTIVE AGE DETERMINATION METHODS. Hart, S. R. (Carnegie Institution of Washington, Washington, D. C.). Trans. Amer. Geophys. Union, 47: 280-6(Mar. 1966).

An attempt is made to summarize what is presently known about age determination methods (^{14}C excepted), their strengths and weaknesses and the trends of current usage. (B.G.D.)

23326 ISOTOPE GEOCHEMISTRY OF OXYGEN AND HYDROGEN: A BRIEF REVIEW. Taylor, Hugh P. Jr. (California Inst. of Tech., Pasadena). Trans. Amer. Geophys. Union, 47: 287-90(Mar. 1966).

A brief report on current research problems in isotope geochemistry is presented. These problems are, oxygen isotope geothermometry, the origin of natural waters, and large scale isotopic exchange during metamorphism. (B.G.D.)

23327 ISOTOPIC DATING OF ARIZONA ORE DEPOSITS. Mauger, R. L.; Damon, P. E.; Giletti, B. J. (Univ. of Arizona, Tucson). Trans. Soc. Mining Eng., 232: 81-7(Mar. 1965).

Use of the lead isotopic dating method as applied to galenas is described, as well as the K-Ar method applied to the dating of a Laramide porphyry copper deposit in the Silver Bell Mining District. The lead isotopic data support prior age assignments based on geologic inference. The Silver Bell study illustrates the necessity of correlative geologic and petrographic investigations for interpretation of the results of potassium-argon dating. The results on galenas from Arizona ore deposits, analyzed for lead isotope ratios, were used to calculate model ages by the method of Russell, Stanton, and Farquhar in which the age is calculated directly from the ^{206}Pb and ^{207}Pb ratio. The use of this ratio eliminates errors inherent in measuring the abundance of ^{204}Pb. Deposition of the older volcanic section, intrusion of monzonite, and mineralization at Silver Bell are included within the Laramide interval, 52 to 77 Myr, an interval during which widespread volcanism, intrusion, and mineralization occurred in southern Arizona. At Silver Bell, mineralization followed crystallization of the host monzonite closely in time, and the ages of mineralized and unmineralized plutons were not separable within the precision limits for the K-Ar method. At Silver Bell, the mineralized monzonite was uncovered and exposed to weathering prior to the late Oligocene-early Miocene volcanic activity. Uplift of the Catalina Mountains Block was similar in age to mid-Tertiary volcanic activity at Silver Bell. (BBB)

23328 THE GENERAL CIRCULATION OF THE ATMOSPHERE AS DEDUCED WITH THE AID OF TRACERS. Bolin, B. WMO (World Meteorol. Organ.), Tech. Note No. 68, 27-56(1965).

Available data on the use of tracers in studies of the general circulation of the atmosphere are summarized. The properties and uses of naturally occurring and injected tracers, both stable and radioactive, are outlined. These tracers include CO_2, ozone, water vapor, ^{222}Rn and ^{220}Rn and their daughters, cosmic-ray produced radioactivity, bomb-produced radioisotopes, total β activity, tritium, ^{14}C, ^{185}W, and ^{102}Rh. Conclusions drawn from available data and areas in which more data are needed are discussed. Likely fallout distributions from known injections of radioactivity in different parts of the atmosphere are considered. In general statements that can be made at present are largely statistical in nature. (45 references) (A.G.W.)

23329 K-Ar AGE DETERMINATION OF ULTRABASITES OF THE BALTIC SHIELD. Kirsten, T.; Gentner, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Naturforsch., 21a: 119-26(Jan.-Feb. 1966). (In German).

The K-Ar-ages of five ultrabasic rocks from the Baltic Shield were determined. K-Ar-ages of 3.7 to 8.8×10^9 y were obtained. Two samples were cut into fractions with different potassium content and a partial correlation of the argon content with the potassium content in the separated fractions was noticed. The question of extraneous argon causing higher age values is discussed. Taking into consideration the previous results obtained by Gerling et al. it may be said that extremely high $^{40}Ar/K$-ratios are the rule for ultrabasic rocks from the Baltic Shield. As a consequence of this fact, it is not likely that all these rocks have the age only of the precambrian pluton in which they are incorporated. Assuming that the alpinotype peridotites were transported upwards in the form of solid fractions from the upper mantle, it is possible, that actually radiogenic argon exists more or less in the sample. The highest $^{40}Ar/K$-ratios (according to ages ranging from 5.9 to 10.9×10^9 y) exhibit the samples with potassium contents below 100 ppm. Samples with potassium contents more than 1‰

have much smaller $^{40}Ar/K$-ratios (according to ages from 4.2 to 5×10^9 y). Excess argon probably causes the extremely high "ages" of more than 7×10^9 y. The ages from relative potassium-rich samples will eventually show the true age. The most likely value for this age is 4.2×10^9 y, measured for a peridotite with 0.49% potassium content. (auth)

23330 PROPORTIONAL COUNTER EQUIPMENT FOR SAMPLE DATING WITH AGES EXCEEDING 60,000 YEARS b,p. WITHOUT ENRICHMENT. Geyh, Mebus A. (Niedersaechsisches Landesamt fuer Bodenforschung, Hanover). 8p. (CONF-650652–15). ORiNS. Gmelin, AED-CONF-158-18.

From International ^{14}C and ^{3}H Dating Conference, Pullman, Wash.

Development of ^{14}C-equipment for dating samples with ages exceeding 65000 years without enrichment is discussed. The equation used for determining the maximum age is given and discussed. The limiting accuracy of the ^{14}C equipment was determined by long-time- and temperature-instability investigations for the electronics and for the detectors. The errors in determining the counting rates, due to the long-time instabilities and to aging of tubes are discussed. The multiplication method was used instead of the μ-meson method. This method gives information as to the extent that age determination can be disturbed by gas impurities. Methods for preparing the samples are described. The slope of the ^{14}C background plateaus amounts to about 2%/100 v. with a graduated shielding and a channel width from 5 to 150 Mv, the following standard values for counting rates were measured: No ≈ 4 cpm and Ns ≈ 130 cpm. From these values a detectable maximum age of 65000 years was calculated, if a limiting accuracy of 4% is accepted and k = 2 is chosen. (F.J.H.)

Thorium and Uranium Minerals

23331 SCHROECKINGERITE AND META-URANOPILITE FROM WALBRZYCH (LOWER SILESIA). Plewa, M. (School of Mining and Metallurgy, Krakow). Bull. Acad. Pol. Sci., Ser. Sci. Geol. Georgr., 13: 101-4(1965).

X-ray diffraction data are provided for two uranium minerals found at the Mieszko coal mine in Walbrzych, Lower Silesia. They occur in form of efflorescences and coatings on the cracking surfaces of coal seams, as well as of igneous rocks of the rhyolite type, and carbonate veins intersecting igneous rocks. The minerals were identified as schroeckingerite and meta-uranopilite. Schroeckingerite appeared in the form of a fine, greenish-white coating and globular aggregates of up to 0.5 mm diameter filling the small fissures in some coal seams, and in igneous rocks intruding in carbon formations. It was also found in some places in coarse crystalline greyish-white dolomite veins intersecting igneous rocks. To ascertain the radioactive properties of the mineral, it was investigated by microautoradiography. The length of the alpha track was 7 to 12 μ, indicating that the mineral contains uranium. Meta-uranopilite occurred in the form of fine lemon-yellow efflorescences and coatings in the fissures of dark grey, coarsely structured dolomite, intersecting, in the form of a vertical vein, the intrusion of igneous rocks. The mineral is very soft, brittle, and under a light pressure disintegrates to dust. It is characterized by a distinct greenish-yellow luminescence. The mineral forms needle-to-lath-like crystals of 0.01 to 0.03 mm length, up to 0.005 mm thick, frequently in irregular or semiradial aggregates. Microautoradiographic tests showed that the lengths of the alpha tracks were 10 to 15 μ, i.e., characteristic of uranium. (BBB)

23332 STUDY OF SECONDARY URANIFEROUS MINERALIZATIONS OF THE BRUGEAUD MINE (LIMOUSINE, FRANCE). Kosztolanyi, Charles; Dullier, Bernard (Centre de Recherches Radiogeologiques, Nancy). Compt. Rend., Ser. D, 262: 1043-5(Mar. 7, 1966). (In French).

During a determination of absolute ages by the lead method of a series of samples coming from 18 samplings made in the Brugeaud mine, the presence of secondary minerals was identified. Previously secondary mineralizations have not been reported. It was found that the lead in one of the minerals comes from radiogenetic lead of previous minerals. (tr-auth)

23333 DISTRIBUTION OF THORIUM IN VARIOUS SOILS. Rubtsov, D. M. Pochvovedenie, No. 3, 55-67 (Mar. 1966). (In Russian).

Different concentrations of thorium and its decay products in soils cause different levels of γ radiation output above the surface of the soil mantle. The concentration of thorium in fine grain soil, that is, products of weathering and soil formation, is higher than in basement rock-schists with layers of quartzite. Increased concentration of thorium in the fine grain soil is related to processes of weathering and soil formation. The fluctuating concentration of thorium in the soil determines basically the concentration of thoron in the air near the ground. The presence of thorium in vegetable objects indicates that it is in the biological cycle in nature. The uptake of thorium in vegetative objects is determined not only by the concentration of thorium in the fine grained soil but is also regulated by the species of vegetative association and by the trend in the soil-making process. The processes of soil formation, characteristic of a bioclimatic zone, appear as the basic source of the transdistribution of thorium in the soil profile. (tr-auth)

HEALTH AND SAFETY

See also BIOLOGY AND MEDICINE — Radiation Hazards and Protection
GEOLOGY, METEOROLOGY, AND MINERALOGY — Natural Radioactivity and Fallout

Refer also to abstracts 22853, 23296, 23463, 23545, 23628, 23823, and 24757.

23334 (AAEC-TM-307) THE ESTIMATION OF EFFLUENT CONCENTRATIONS FROM AN ELEVATED CONTINUOUS SOURCE. Charash, E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec. 1965. 26p. Dep. mn.

From fundamental theory and empirical knowledge of the structure of atmospheric turbulence spectra, diffusion equations were developed with parameters that are adjustable so as to reflect the influence of varying surface roughness as well as a wide range of stability conditions. Instructions are given for practical applications of the diffusion equations which should be valid for travel distances of about a mile at heights greater than fifty feet above ground. (auth)

23335 (AD-621120) DIGITAL COMPUTER AUTOMATION OF WHOLE-BODY RADIOISOTOPE DETERMINATION [Thesis]. Dombek, Frank Stanley (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering). Aug. 1965. 91p. (GNE-Phys-65-4). CFSTI $3.00 cy, $0.75 mn.

The digital computer, automatic unscrambling of the gamma-ray spectra from a whole-body counter, is accomplished by a Fortran II computer code suitable for the IBM-1620 or similar machines. The code is designed for specific use with the USAF Radiological Health Laboratories' whole-body counting facility but might be used in any similar spectral analysis operation. The USAF facility is described. The code will determine relative intensities of any eight or less internal emitters in a complex spectrum, so long as the separate spectra of these emitters are contained in the input. The reduction of the complex spectra is accomplished by the least squares method. Application of the code to sample spectra of known isotopic compositions for dosed phantoms and in vivo human testing yields maximum errors of the order of three to four percent with respect to peak analysis methods. (auth)

23336 (AD-621270) DIGITAL COMPUTER AUTOMATION OF BODY BURDEN RETENTION DETERMINATIONS. Dombek, Frank Stanley (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering). Aug. 1965. 46p. (GNE-65-10). CFSTI $2.00 cy, $0.50 mn.

A method of unscrambling a complex homogenization of individual exponential functions was developed. Essentially the problem reduces to, given a set of experimental data known to consist of a series of different exponential decay functions, find each of these functions. The mathematical technique chosen for the investigation was that of non-linear least-squares. Utilizing the method of least squares, a computer program was written, BRAT (Biological Retention Analysis Technique) in Kingstran for the IBM-1620. The program itself was developed for the USAF Radiological Health Laboratories, although its application to other compositions with exponential decay is obvious. (auth)

23337 (AD-624516) SAMPLING PROGRAM FOR AIRBORNE RADIOACTIVITY. Bowie, Donald R. (Army Medical Research Lab. (5th), St. Louis, Mo.). Jan. 31, 1965. 30p. CFSTI $2.00 cy, $0.50 mn.

The basic program involves the collection of particulate matter from a known volume of air. The collector is a high volume sampler equipped with a glass fiber filter. The gross beta radiation emitted by a known fraction of the sample is measured in an appropriate instrument, and the concentration is calculated for the sampling period. (TAB)

23338 (AD-624870) TRAINING REQUIREMENTS FOR POSTATTACK ADAPTIVE BEHAVIOR. Final Report. Teal, Gilbert E.; Fabrizio, Ralph A.; Barnes, Stanley M.; Moeller, William A. (Dunlap and Associates, Inc., Darien, Conn.). Dec. 1965. Contract OCD-PS-65-33. 114p. CFSTI $4.00 cy, $0.75 mn.

The study is aimed at identifying actions required of and beneficial to individuals in a post-attack environment and developing guidelines concerning content and methods of training that would generate adaptive behavior. Methods of study were limited to literature review and scientific argument. Two major training objectives are specified: training to meet the requirements of individual survival; and of societal recovery. It is recommended that training materials be stocked in public shelters to support these objectives. It is also recommended that certain information basic to education of the public in emergency measures be prepared for timely use in mass communication media at such times as crises or disasters provide the essential motivation to learn. It is suggested that training is the responsibility mainly of local community political authority. (auth)

23339 (AD-625752) ENGINEERING STUDY OF ATOMIC BLAST-RESISTANT DESIGN FOR SEVERAL DIFFERENT BUILDING TYPES. (Ammann and Whitney, New York). Mar. 1960. Contract DA-49-129-eng-317. 206p. CFSTI $6.00 cy, $1.25 mn.

The results are summarized of an engineering study of several building types to determine (1) the practicability of design for atomic blast resistance, (2) the estimated construction cost for a range of blast pressure loadings and a comparison of costs with conventional construction, and (3) the estimated additional cost of providing personnel shelter areas. (TAB)

23340 (AD-625753) ENGINEERING STUDY OF ATOMIC BLAST-RESISTANT DESIGN FOR SEVERAL BUILDING TYPES. Appendix H. (Ammann and Whitney, New York). Mar. 1960. Contract DA-49-129-eng-317. 67p. CFSTI $3.00 cy, $1.25 mn.

Drawings are given on protective construction for administration building; communications building; warehouse; earth-covered concrete igloo, rectangular, doublebarrel arch, and dome; and buried rectangular, doublebarrel arch, dome, and concrete igloo. (TAB)

23341 (AD-625782) YIELDING MEMBRANE ELEMENTS IN PROTECTIVE CONSTRUCTION. Final Report. Harrenstein, H.; Gunderson, R.; Hansen, S.; Burnsand, J.; Salmons, J. (Arizona Univ., Tucson. Engineering Research Lab.). May 28, 1965. Contract OCD-OS-64-187. 123p. CFSTI $4.00 cy, $0.75 mn.

An investigation was made of the feasibility of the application of doubly-curved shell structures to the problem of sheltering people from the blast effects of nuclear weapons. The steel shell works best in tension. Under certain conditions a ¼ inch thick steel membrane will carry more load than a 19 inch thick concrete slab reinforced with steel at a rate of 4.08 inches per square foot. The membrane itself uses less steel than the reinforced concrete slab. Favorable soil-structure interaction effects are introduced with the yielding membranes. Boundary supports and full scale testing are items that need more attention as parts of future investigation. (auth)

23342 (AD-627516) DESIGN PROCEDURES FOR SHOCK ISOLATION SYSTEMS OF UNDERGROUND PROTECTIVE STRUCTURES. VOLUME V. RESPONSE SPECTRA OF MULTI-DEGREE-OF-FREEDOM ELASTIC SYSTEMS. [Period Covered], November 1963–January 1965. Newmark, N. M.; Walker, W. H.; Mosborg, R. J.

(MRD Div., General American Transportation Corp., Niles, Ill.). Dec. 1965. Contract AF29(601)-6253. 126p. (RTD-TDR-63-3096(Vol.5)). CFSTI $4.00 cy, $1.00 mn.

A discussion is presented on maximum response for multi-degree-of-freedom elastic systems considering five-degree-of-freedom systems in some detail, with some results for ten-degree-of-freedom systems and other systems for which data are available in the literature. Included are tabulations of response data computed from step by step integration of the equations of motion for five different forms of ground excitation on a number of systems having varying parameters of mass and stiffness distribution. The results are compared with the modal responses for the same systems, and general rules are developed for comparing the true responses with various combinations of the modal response data. Consideration is given to treatment of a multi-degree-of-freedom system as a continuous shear beam, and some generalizations are drawn from the study which enable a better interpretation of the results of the specific data tabulated. Some suggestions arising from previous studies are made to take into account the behavior of multi-degree-of-freedom systems in the inelastic range. (auth)

23343 (AD-631529) DEVELOPMENT AND TEST OF A SOD-REMOVAL PROCEDURE FOR MOIST LAWNS CONTAMINATED BY SIMULATED FALLOUT. Cobbin, W. C.; Owen, W. L. (Naval Radiological Defense Lab., San Francisco, Calif.). Apr. 10, 1965. 73p. (USNRDL-TR-965). CFSTI $3.00 cy, $0.75 mn.

A sod-cutting machine was evaluated for its usefulness in the radiological reclamation of small lawn areas—some of which were confined by sidewalks, trees, and buildings. Fallout conditions were simulated by contaminating lawn test areas with labeled sand. Nominal particle size ranges of 44–88, 88–177, 177–350, and 350–700 μ were used. This fallout simulant was dispersed at nominal concentrations of 25, 50, and 100 g/ft^2, respectively. Reclamation effectiveness of sod cutting was dependent upon machine factors (blade depth), soil characteristics (moisture content), and fallout simulant properties (mass loading). The least effective sod removal results were obtained in confined lawns with high moisture content and heavy rock concentrations. The best sod cutting and removal effectiveness results were obtained on more accessible lawns having less moisture content and only a light concentration of rocks. Simulant particle size was found to have little, if any, effect upon reclamation performance either with respect to effort required or removal effectiveness achieved. (auth)

23344 (AEET-240) SOME ASPECTS OF FALLOUT FROM THE FIRST AND SECOND CHINESE TESTS. Vohra, K. G. (Atomic Energy Establishment, Trombay (India)). 1965. 28p. Dep. mn.

The pattern of movement of fallout debris clouds after the first and second Chinese tests was studied with the help of wind data at 200 mb level. Samples of fallout debris collected at high altitudes with the help of commercial aircraft were studied for freshly produced fission products and detailed analysis was carried out for several short-lived isotopes. Details of analysis used for rapid identification of fissile materials after the two tests are presented. Activity ratios of important short-lived fission products for both of the tests showed U-235 fission. The results of analysis for Np-239 and U-237 are also given. These analyses provide evidence of production of U-237 by double neutron capture and of Np-239 by neutron activation of U-238. The airborne radioactivity found at Gulmarg after the second Chinese test is discussed. (auth)

23345 (AFRRI-CR-65-2) A COMPARATIVE STUDY OF RADIOACTIVE SOURCE ARRANGEMENTS FOR SIMULATING FALLOUT GAMMA RADIATION FIELDS. French, R. L. (Radiation Research Associates, Inc., Fort Worth, Tex.). June 1964. Contract DA-49-146-XZ-254. 111p.

Monte Carlo techniques were used in a study of three basically different approaches to simulating the gamma radiation environment near the air/ground interface due to fallout uniformly distributed on the ground surface. The energy and angular distribution of the photon flux at a receiver 3 feet above the ground due to a ^{60}Co point isotropic source also three feet above the ground and at separation distances of 100 to 800 feet was computed, and the results were found to bear little resemblance to those from a uniform fallout field. Results computed for a receiver position three feet above idealized ^{144}Ce, ^{137}Cs, and ^{60}Co infinite plane sources on the ground indicated good simulation of the angular distribution of the gamma dose and, except for energies greater than 1.25 Mev, reasonable simulation of the energy spectra from fallout. A third source arrangement, called the compact simulator, was found to simulate the fallout gamma radiation environment equally well. The compact simulator utilized ^{144}Ce, ^{137}Cs, and ^{60}Co in a finite plane source 60 feet in radius and in an elevated toroidal source which acts as a virtual source for the remainder of the infinite plane. In the compact simulator, an overhead slab of water acts as a reflector to simulate air scattering. (auth)

23346 (BLG-365(Vol.1)) DIFFUSION DES REJETS ATMOSPHERIQUES DANS LA REGION DE MOL. (Diffusion of Atmospheric Effluents in the Vicinity of Mol). Bultynck, H.; de Maere, X.; van der Parren, J.; Malet, L. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Dec. 1965. 68p. Dep. mn.

The general theory on atmospheric diffusion was applied to discharges at the nuclear establishment in Mol, taking into account the characteristics of the site. Five categories of thermal equilibrium were adopted and a separate approach is proposed for the cases of fumigation. The loss of material in the plumes due to settling, dry deposition, and wash-out was considered and appropriate correction factors were adopted. A mathematical model was developed to treat the problems of possible contamination of the atmosphere and of the surface in the environment, in case of releases of long duration. This model led to the construction of polar diagrams of integrated concentrations in the air or average deposition on the ground. A comprehensive set of diagrams is given in order to facilitate determination of the dilution factors. (auth)

23347 (BNWL-SA-572) CONTAMINATION OF SOFT TISSUES OF INFANTS AND CHILDREN WITH RADIOACTIVE FALLOUT AS EXEMPLIFIED BY ^{137}Cs AND ^{131}I. Hanson, W. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 7, 1966. Contract AT(45-1)-1830. 25p. (CONF-660309-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Conference on Pediatric Significance of Peacetime Radioactive Fallout, San Digeo, Calif.

Amounts, routes, and rate of ^{137}Cs accumulation in Alaskan Eskimo and Indian populations are discussed. In the Arctic ecologic factors facilitate the effective transfer of ^{137}Cs through the lichen to caribou to man food web. The distributions of ^{137}Cs body burdens within Alaskan native populations showed important influences of ethnic background and cultural practices of the people. Cesium-137 concentrations were greatest in persons consuming the largest amounts of caribou flesh and were inversely related to age. No variation with sex was noted. Whole-body dosage to the Anatuvuk Pass population during 1964 was about 30% of the amount recommended as maximum permissible. (H.G.D.)

23348 (CEA-R-2908) INFLUENCE DE L'HUMIDITE ET DE LA CONCENTRATION EN IODE SUR L'ADSORPTION DE L'IODE 131 PAR LES CHARBONS ACTIFS. (Influence of Humidity and Iodine Concentration on the Adsorption of Iodine-131 by Activated Charcoals). Billard, Francois; Chevalier, Gerard; Caron, Jacques; Van Der Meersch, Jean (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan. 1966. 23p. (CONF-650407-14). Dep. mn.

From International Symposium on Fission Product Release and Transport under Accident Conditions, Oak Ridge, Tenn.

Following an outline of the means of generating iodine-131 in the gas phase and a brief description of the apparatus used, experimental results obtained on the trapping of iodine-131 by activated charcoal were analyzed. The generation of ^{131}I in the gas phase is outlined, and the apparatus used is described. The efficiency depends concurrently on the relative humidity and iodine concentration of the air. While it is independent of this concentration in dry air, it does not exceed 50 in moist air, whatever the bed depth, when the concentration is less than 1 mC/m^3, then it increases with the concentrations to reach values close to those obtained in dry air for concentrations of around 1000 C/m^3. At the same time the efficiency of a dust filter with respect to iodine remains very low in dry air whatever the iodine concentration; in moist air this efficiency, which is high at low concentrations, decreases when the latter increases. Also, if a charcoal bed is divided, separated by an amount corresponding to a passage time of about a second, it was found that the efficiency of the whole is appreciably higher than that of the initial bed. The results appear to establish the existence of at least two forms of iodine, one molecular form and one particulate form probably formed by clusters, the forms' equilibrium being functions of the relative concentrations of iodine and water vapor in the air. The third form evidence, a gaseous form compound, remains hypothetical; the experimental curves can be explained either by the molecular and particular forms' reversibility or by the increase of cluster size with the relative humidity of the air. (auth)

23349 (CEA-R-2931) ETUDE SUR L'EXTINCTION DES FEUX DE PLUTONIUM EN BOITES A GANTS. (Study of Plutonium Fire Extinction in Glove Boxes). Boisson, Henri; Chappellier, Andre; Debiar, Alain; Savornin, Jacques (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1965. 16p. Dep. mn.

Attempts to extinguish uranium and plutonium fires in glove boxes are reported. The extinguishing powders TEC and MG 10 were used and compared. The metal was dealt with in the form of billets, compact chips, and thin shavings. In each case, fire control was without difficulty, however, time for cooling must be considered. The powder MG 10 showed very good results. Moreover, the trials proved that densely packed shavings are a very real security factor. The interior lay-out of the glove boxes should be such as to render extinction as easy as possible should the need arise. (auth)

23350 (CF-52-10-230(Del.)) SECOND INFORMATION MEETING, HOT LABORATORIES AND EQUIPMENT HELD AT OAK RIDGE NATIONAL LABORATORY, OCTOBER 7–9, 1952. (Oak Ridge National Lab., Tenn.). July 31, 1953. Contract W-7405-eng-26. 264p. Dep. mn. CFSTI $6.00 cy, $1.25 mn.

Thirty-one articles are included on developments in hot laboratories and equipment. The equipment described include: glove boxes; remote processing equipment, solidification cells for high-level radioactive aqueous wastes; antiswing crane; gamma-neutron radiation chamber for radiobiology; shielded containers; cobalt-60 irradiation chambers; and remote-control equipment; various hot cells are also described. (P.C.H.)

23351 (CONF-640413) SEMINAIRE SUR LA PROTECTION CONTRE LES DANGERS DU TRITIUM, LE VESINET, 16–18 AVRIL 1964. (Seminar on the Protection Against the Dangers of Tritium, Le Vesinet, France, April 16–18, 1964). (Health Physics Society. French Section. Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France). Societe Europeenne de Protection Contre les Rayonnements). 138p. Dep. mn. Service Central de Protection Contre les Rayonnements Ionisants Free.

The 23 papers, together with the discussions following their presentation, presented at the seminar at Le Vesinet on protection against the dangers of tritium are compiled. Individual abstracts were prepared for each. (J.S.R.)

For abstracts of individual papers see: 22545, 22546, 23320, and 23352–23371.

23352 (CONF-640413, pp 28-33) PRODUCTION OF TRITIUM IN NUCLEAR REACTORS. Bramati, L. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)).

The production of tritium in nuclear reactors by the activation of trace materials such as deuterium and lithium is considered. After some theoretical considerations on the various sources of tritium, the principal types of reactors and the corresponding amounts of tritium formed are briefly examined. It is shown that the only type of reactor where the tritium hazards are real is the graphite–gas reactor and heavy water reactors. The methods of measurement and the results obtained in the Latina reactor are reported. (tr-auth)

23353 (CONF-640413, pp 1-3) RADIATION HAZARDS ASSOCIATED WITH TRITIUM. Morgan, Karl Z. (Oak Ridge National Lab., Tenn.).

Although tritium is not considered one of the more dangerous products resulting from reactor accidents, it does present some dangers. The reasons that tritium should be handled with caution are summarized. (J.S.R.)

23354 (CONF-640413, pp 5-9) CONTAMINATION PAR LE TRITIUM A PARTIR DE L'ATMOSPHERE. (Contamination by Tritium From the Atmosphere). Roulin, J. (Centre d'Etudes et de Recherches Atomiques Militaires, Fort d'Aubervilliers (France)).

From the literature available, the possible sources of atmospheric tritium (cosmic radiation, extraterrestrial tritium, thermonuclear explosions, and reactors) are analyzed. The relative importance of various chemical species incorporating tritium, such as molecular tritiated hydrogen, tritiated water, and tritiated methane, is discussed. Some hypotheses leading to soil contamination by tritium are suggested. (tr-auth)

23355 (CONF-640413, pp 10-16) SURVEY OF AVAILABLE DATA OF TRITIUM. Brunner, H. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)).

A brief survey of the physical, chemical, and biological data available on tritium is given in order to give a basis and a reference for the seminar discussions. Some data on maximum permissible concentrations and contamination limits are included. (tr-auth)

23356 (CONF-640413, pp 17-26) RISQUES PRESENTES PAR LA DIFFUSION DE GRANDES QUANTITES DE TRITIUM DANS L'ATMOSPHERE. (Dangers Presented by the Diffusion of Large Quantities of Tritium in the Atmosphere). Doury, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

Some of the available data on the amount of naturally occurring tritium and the processes associated with the diffusion of hydrogen and its isotopes are briefly reviewed. Theoretical evaluations are made of potential maximum concentrations resulting from the accidental release of large amounts of tritium in the atmosphere. The case of continuous release is also considered. On the basis of an assumption on the rate of isotopic exchange between gaseous tritium and water vapor and by a consideration of the external or internal doses that can be received during exposure to a contaminated area, the orders of magnitude of the maximum permissible quantities that can be discharged continually or at one time are given within the limits of the recommendations of the International Commission on Radiation Protection. (tr-auth)

23357 (CONF-640413, pp 34-9) HAZARDS OF TRITIUM OXIDES INDUCED IN HEAVY WATER REACTORS. Holmquist, C. E. (Swedish State Power Board, Stockholm).

The tritium activity induced in a heavy-water moderated and cooled power reactor presents some problems of considerable health significance. These problems increase with with the operation time of the reactor. The activity will be approximately 10 c DTO/D_2O after 10 years of operation. Unlike the fission product activity that is contained within the cladding of the fuel element, this activity is a constant hazard because of its vapor pressure from DTO. The health physics consequences of this in the operation of a full size

nuclear power plant are the following: The personal protection must include a scrupulous industrial hygiene survey of the internal uptake and an extensive use of plastic suits. The layout of the station and the ventilation requirements will be greatly affected. Decontamination procedures will be complicated through the risk of internal contamination through lungs and skin. The environmental survey must include as a major item the tritium fallout around the power plant and the concentration in milk. Even minor mishaps in the operation of the plant may involve a pronounced internal risk. The discharge of the liquid effluent of low level tritium activity to a lake requires careful study of its capacity to act as a recipient for tritium since ordinary waste treatment is not successful in reducing this activity. (auth)

23358 (CONF-640413, pp 40-52) STUDIES ON TRITIUM HAZARDS AT SWEDISH REACTORS. Bergstroem, S. O. W.; Devell, L.; Gebert, G. (Aktiebolaget Atomenergi, Studsvik (Sweden)).

The tritium levels in the present and future Swedish reactors are given. The general aspects of tritium hazards in connection with operation of reactors (mainly heavy-water reactors) are discussed. The significance of health criteria for personnel and for the environment is compared with the economic restrictions which have to be applied to heavy water leak rates. The effect of tritium air levels on work routines, layout, and system design is considered. Laboratory test of tritium permeability through various polymer films are briefly described. Results from full-scale tests of 1-piece and 2-piece polyvinyl chloride suits are discussed. A butyl rubber 1-piece suit especially designed for work with tritium is described. The sorption of tritiated water on oxide films of steel and iron was investigated and some typical results are given. (auth)

23359 (CONF-640413, pp 62-6) DETECTION ET MESURE DE LA CONTAMINATION DES GAZ ET VAPEURS. (Detection and Measurement of the Contamination of Gases and Vapors). Patigny, P. (Centre d'Etudes et de Recherches Atomiques Militaires, Fort d'Aubervilliers (France)).

An instrument was designed for sampling tritium in an atmosphere highly contaminated with fission products. This device takes atmospheric air samples, oxidizes tritiated molecular hydrogen, destroys the unstable metallic hydrides or tritides, and recovers all of the tritiated water vapor. The fission products are separated by a filtration system and the gaseous products are removed by vacuum distillation and retained in traps. (tr-auth)

23360 (CONF-640413, pp 53-61) DETECTION ET MESURE DE LA CONTAMINATION PAR LE TRITIUM DES GAZ ET VAPEURS. (Detection and Measurement of Contamination of Gases and Vapors by Tritium). Soudain, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

A device for the monitoring of atmospheric tritium content at the maximum permissible concentration level and a method for the calibration of this device are described. The instrument design is considered with respect to the distinction recently made between the hazards of elementary tritium and from tritium combined with water. It is possible with the equipment described to determine tritium in the presence of another radioactive gas such as ^{41}Ar. (tr-auth)

23361 (CONF-640413, pp 67-9) MESSGERAET FUER TRITIUM. (Measurement Device for Tritium). Berthold, F. (Laboratorium Prof. Dr. Berthold, Wildbad im Schwarzwald (West Germany)).

A discontinuous monitor for tritium in the air and a device for measurement of the tritium contamination are described. In the discontinuous monitor samples from the monitor area are taken by opening the tap of an evacuated glass ampule and filling it with air at atmospheric pressure. With a vacuum device, the gaseous proportional counters are filled with more than 50% of this air and with methane. High-efficiency and good plateau characteristics were obtained for the counting. A laboratory model of the device for the measurement of α and β surface contamination that makes possible tritium dosimetry is then described. This device was constructed from a detector already available for the measurement, without contact, of tritium and other sources of radiation. This counter consists of a single wire stretched parallel to the surface. It was compared to a proportional counter with several wires parallel to the surface. Methane makes possible excellent counting efficiency with a high yield. For the measurement of tritium a windowless counter provided with a cathode grid that can be placed on the surface is needed. (tr-auth)

23362 (CONF-640413, pp 70-4) ETALONNAGE DE LA CHAMBRE D'IONISATION DIFFERENTIELLE TYPE CD2 EN VUE DE LA DOSIMETRIE DU TRITIUM DANS L'ATMOSPHERE. (Calibration of the Type CD_2 Differential Ionization Chamber With Respect to the Dosimetry of Tritium in the Atmosphere). Chretien, L.; Cluchet, J.; Tabot, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

The detection of tritium in gas or water vapor form is possible with a differential ionization chamber compensating the background. The measurements can be made either continuously or by the sampling technique. A device that was adapted for calibration of the detector is described. An instantaneous constant concentration can be obtained in the chamber at will. With this device the linearity of the chamber between 10^{-6} and 10^{-2} cm^{-3} could be verified and the value of the detection efficiency could be obtained. (tr-auth)

23363 (CONF-640413, pp 83-6) KONTINUIERLICHE TRITIUM-UEBERWACHUNG IN LUFT UND WASSER. (Continuous Tritium Monitoring in Air and Water). Kiefer, H.; Maushart, R. (Kernforschungszentrum, Karlsruhe (West Germany)).

After a review of the methods presently employed for the continuous monitoring of tritium, the difficulties in the detection of this emitter with extremely low β energy are discussed. Both the techniques and the measurements are considered in this discussion since tritium can be present in the form of gaseous hydrogen, water vapor, or organic compounds. In most cases the measurements of tritium are not specific; these methods are not capable of distinguishing between tritium and other sources of β radiation. The use of large-volume proportional counters operating in the pulse region combined with proportional counters for the discrimination of higher energy radiation using the spatial anti-coincidence principle makes possible a specific continuous monitoring of tritium in air and water. During the measurement of air, air in the proportion of 1/3 is added to the continuous flow of methane being used as a counting gas. The sensitivity is approximately 10^{-8} $\mu C/cm^3$ of air. During the measurement in water, the dry methane is enriched with water vapor, and the sensitivity is approximately 1×10^{-4} $\mu C/cm^3$ of air. The results of the first experiments made with this type of apparatus are reported. (tr-auth)

23364 (CONF-640413, pp 75-82) DOSIMETRIE DE LA VAPEUR D'EAU TRITIEE AUPRES DES PILES A EAU LOURDE. (Dosimetry of Tritiated Water Vapor Around Heavy Water Reactors). Fitoussi, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

A brief survey is given of the problems related to tritium around heavy-water reactors. A method for the dosimetry of tritiated water vapor using a coincidence counter operated in the Geiger region is described. This method, which has a high selectivity, makes it possible to measure activities of the order of 10^{-9} C/cm^3 of sampled water vapor, corresponding approximately under normal hydrometric conditions to an atmospheric contamination rate of 10^{-3} maximum permissible concentration. The time necessary to carry out these measurements is lower than that necessary for scintillation detectors in liquids. (tr-auth)

23365 (CONF-640413, pp 87-90) APPLICATION DE LA DOSIMETRIE PAR LES SCINTILLATEURS LIQUIDES A LA PROTECTION CONTRE LES RADIATIONS. (Application

of Liquid Scintillation Dosimetry to Protection Against Radiation). Leblanc, P.; Bal, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

The technique for the detection of low-energy β radiation by scintillation counters developed by Roucayrol et al. was used in the measurement of tritium in high-activity laboratories. By the use of different scintillation liquids, this apparatus can be used for the measurement of the activity of tritiated water vapor and for the discontinuous monitoring of the atmosphere. This complements the continuous control given by ionization chambers. Its utilization has special advantages for the measurement of the activity of surface contamination using the smear technique, for the measurement of the activity of working clothes and materials, and for the testing of the skin decontamination. (tr-auth)

23366 (CONF-640413, pp 92-7) L'INTERVENTION ET LA DECONTAMINATION DU MATERIEL CONTAMINE AU TRITIUM. (The Intervention and the Decontamination of Material Contaminated With Tritium). Cerre, P.; Mestre, E. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

The methods used for emergency teams during work on equipment and materials contaminated by tritium are outlined. The protection of personnel and material is also examined. The techniques used in the decontamination of equipment are described and some examples illustrate the results obtained in their use. The laboratory program to be undertaken for the improvement of decontamination factors is given. (tr-auth)

23367 (CONF-640413, pp 98-102) DETECTION DES CONTAMINATIONS DE SURFACE. (Detection of Surface Contaminations). Gourski, E.; Boulenger, R.; Koch, G. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)).

The low β energy of tritium necessitates the introduction of the sample into the sensitive volume of the detector. For the direct detection of contamination, a windowless gas-flow proportional counter was constructed. It can be used for measurements within a few seconds after being placed on a flat insulating surface. The indirect measurement of the contamination is made by a scintillation liquid on the washings. Solvents that can be used as components of the scintillating mixture are used as far as possible for these washings. The technique can be applied to irregular surfaces such as the skin. These methods are used for the routine monitoring of a radiochemical laboratory at the Mol Center of Nuclear Studies. (tr-auth)

23368 (CONF-640413, pp 103-6) CONTROLE DE LA CONTAMINATION EN TRITIUM DANS LES LABORATOIRES DE HAUTE ACTIVITE DU CENTRE D'ETUDES NUCLEAIRES DE SACLAY. (Control of the Tritium Contamination in High Activity Laboratories of the Saclay Center of Nuclear Studies). Bal, G.; Werderer, B. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

The different methods used for the control of tritium contamination in radiochemical laboratories are enumerated. The atmospheric contamination is detected with differential ionization chambers measuring the total tritium contamination. If there is an increase of this contamination a selective measurement of the tritiated water is made. Experience has shown that the CD2 differential chamber with interior coating of copper and of zinc can be particularly contaminated by tritiated water. This phenomenon does not seem to appear with stainless steel chambers. In order to control the readings of these chambers, samplings of the water vapor is made by condensation and the concentration of tritiated water is determined with a hygrometry measurement. Experience has shown that this method of measurement furnishes results comparable to those obtained by the differential chambers. The surface contamination is measured by smears using liquid scintillators. (tr-auth)

23369 (CONF-640413, pp 112-16) LE CONTROLE DES PEINTURES RADIOLUMINESCENTES AU TRITIUM EN FRANCE. (The Control of Tritium-Radioluminescent Paints in France). Pellerin, P., de Zertucha, J. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)).

Radioluminescent paints in France, excited by artificial radioisotopes and principally by tritium, are authorized after a certain number of controls and technical tests. The measurements of the radioisotope leakage during the tests were made with a β spectrometer. The detail of the techniques employed, the efficiency, and the results obtained are reported. (tr-auth)

23370 (CONF-640413, pp 117-23) CONCENTRATIONS MAXIMALES ADMISSIBLES POUR LE TRITIUM ET SES COMPOSES. (Maximum Permissible Concentration for Tritium and its Compounds). Verly, W. G. (Liege Univ. (Belgium). Laboratoire des Isotopes).

Results are reported from studies of method used to determine the maximum permissible concentrations of tritium in tritiated water, tritiated hydrogen, tritiated thymidine, and tritiated organic molecules. Tritiated water enters the body through the digestive tract, the respiratory system, and the skin. Their importance is relative. The RBE coefficient is 1.7. The permissible body burden is 0.1 rem/week or 1.2 mC. There is a rapid balancing between the human body compartments, and tritiated water has a biological half life of about 12 days. There is anabolic absorption of tritium in organic molecules. Data on the maximum permissible concentration in air and water are given. Factors affecting the metabolism of tritium in man are discussed. (C.H.)

23371 (CONF-640413, pp 124-7) TRITIUM ET VAPEUR D'EAU TRITIEE: DUREES LIMITES D'EXPOSITION ACCIDENTELLE EN ATMOSPHERE STABLE OU RENOUVELEE. (Tritium and Tritiated Water Vapor: Time Limits of Accidental Exposure in Stable or Renewed Atmosphere). Gey, A. (Commissariat a l'Energie Atomique, Paris (France)).

A theoretical study was made of the permissible exposure time for a person exposed to an atmosphere highly contaminated by tritium. The study is based on an inhaled quantity corresponding to 5 rem/yr. Various cases are considered with respect to the type of accident, the presence or lack of ventilation in the building, and the presence of tritium or tritiated water from the beginning of the accident. Two types of accidents considered include the instantaneous release of Q(curies) or continuous and constant leakage of F (curies/hr). In the case of the presence of tritium or tritiated water from the beginning of the accident, highly optimistic assumptions on the oxidation and on the transfer into the organism of tritium were made for the calculations. The approximate results can be obtained by simple formulas. The modification of some assumptions would lead to easily made corrections to the formulas. (tr-auth)

23372 (GAT-R-379) HEALTH AND SAFETY ACTIVITIES REPORT FOR 1965. (Goodyear Atomic Corp., Piketon, Ohio). May 4, 1966. Contract AT(33-2)-1. 66p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The health and safety program at Goodyear Atomic Corporation is described in detail. Activities during 1965 in the fields of safety, equipment inspections, fire protection and prevention, medical service, industrial hygiene, and health physics are reported. The 1965 accident frequency rate was 1.37, a reduction of 35% from the 1964 rate. Airborne α activity during 1965 increased over the 1964 value, while β-γ airborne activity decreased over the same period. The average annual concentration of both α and β-γ activity in neighboring streams, creeks, and rivers increased over the 1964 values. The overall 1965 annual average background exposure was 27.2% of the maximum permissible exposure level. (C.H.)

23373 (N-65-29998) X-RAY ABSORPTION IN DOSE-EQUATED MATERIALS. Technical Report, January 1-June 1, 1964. Clark, Benton C.; Janni, Joseph F. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). May 1965. 152p. (WL-TR-64-134; AD-616773).

The calculated values and comparisons of x ray interaction parameters for a number of materials are presented so that possible dosimetric media may be directly compared and evaluated with several selected radiation effects media. The photon energies considered range from 0.01 to 100 Mev. The calculational approach as well as the resultant tabulations are presented in detail. (auth)

23374 (NIRS-4, pp 81-7) ENVIRONMENTAL STUDIES. (National Inst. of Radiological Sciences, Chiba (Japan)).

Results are summarized from tracer studies of Sr-Ca discrimination in renal excretion in fish; the effects of ^{137}Cs and ^{90}Sr from fallout on the radioactivity of sewage; the development of a radiochemical method for the determination of small amounts of ^{131}I, ^{132}I, and ^{133}I in water, milk, urine, or thyroid tissue; and the measurement of ^{14}C content in ethanol produced from raw materials from various parts of the world. (C.H.)

23375 (NYO-2539-2) STRUCTURAL INTEGRITY OF SHIPPING CONTAINERS FOR RADIOACTIVE MATERIALS. PART III. ANALYSIS OF CONTAINER TIEDOWN DURING COLLISION OF HIGHWAY VEHICLES. Clarke, H. G. Jr.; Doshi, K. D. (Franklin Inst. Research Labs., Philadelphia, Pa.). Feb. 1966. Contract AT(30-1)-2539. 70p. (I-A2412-3). Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Analytical and graphical procedures are presented for determining approximately the dynamic response of container tiedowns during longitudinal collisions of highway vehicles. The method is based on a simplified model of the vehicle-container-tiedown system and on an assumed force pulse. Illustrative examples are given of the calculated response of a 4-point tiedown made from several different materials. The analytical method is applicable to other tiedown geometries and materials within the limits imposed by the conditions of the derivation. The method should be useful to designers and shippers for comparative evaluation of various tiedowns. (auth)

23376 (ORNL-3913, pp 133-46) NUCLEAR SAFETY. (Oak Ridge National Lab., Tenn.).

Information is presented on nuclear safety tests in major facilities. Laboratory-scale studies in support of nuclear safety are reported. (J.R.D.)

23377 (SC-RR-65-491(Vol.2)) PROJECT SAND FINAL PROGRAM REPORT. VOLUME II. SAND FILTER-SAMPLER ANALYSIS, DEVELOPMENT, AND TESTING. Elrick, R. M.; Rigali, D. J. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1966. Contract AT(29-1)-789. 46p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The capability of filters in the Sand program to collect particles from the upper atmosphere in the 100- to 250-kilofoot range was examined experimentally and theoretically. Results, comparisons, and conclusions are presented in connection with filter testing, and recommendations for increasing particle flow through the sampler filter are given. (auth)

23378 (STI-PUB-98) MANUAL ON ENVIRONMENTAL MONITORING IN NORMAL OPERATION. Safety Series No. 16. (International Atomic Energy Agency, Vienna (Austria)). Mar. 1966. 76p. IAEA: $1.50; S31,50; 9/-stg; F Fr 6,-; DM 4,80.

The objectives, planning, procedures, and programs for environmental monitoring in the vicinity of establishments that discharge radioactive materials to the environment during normal operation are discussed. Manpower and equipment are also considered. Separate abstracts were prepared for five articles that are appended giving examples of routine environmental monitoring programs currently in use in different countries. (P.C.H.)

For abstracts of individual papers see: 23405–23409.

23379 (TID-5360(Suppl.2)) A SUMMARY OF INDUSTRIAL ACCIDENTS IN USAEC FACILITIES. (Division of Technical Information (AEC), Washington, D. C.). Sept. 1959. 33p. Dep. mn. CFSTI $0.50 cy, $0.50 mn.

Industrial and occupational injuries and fatalities in all activities of the Atomic Energy Commission from Jan. 1, 1947, through Dec. 30, 1958, are summarized. Narrative descriptions of all fatal accidents and those involving radiation exposure are included. (C.H.)

23380 (TID-22841) [DOSIMETRY IN HUMAN RADIOEPIDEMIOLOGY]. Progress Report for Period March 15, 1965–March 14, 1966. (International Atomic Energy Agency, Vienna (Austria)). Contract AT(30-1)-2819. 22p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Progress is reported on an epidemiological study of the toxic effects of Thorotrast in some 532 persons known to have been given Thorotrast approximately 20 to 25 years ago for medical reasons. Results are reported on whole-body counts of 60 Thorotrast cases. Studies were also made of chromosome patterns in peripheral blood cells from persons with Thorotrast burdens, a comparison of whole-body counting data on persons containing ^{226}Ra or ^{90}Sr, and attempts were made to determine the whole-body or organ content of ^{220}Ac, ^{208}Tl, ^{228}Ra, ^{224}Ra, and ^{212}Bi in persons with Thorotrast burdens. (C.H.)

23381 (USNRDL-TR-981) AERIAL SURVEY OF THE CONTAMINATED OCEAN SURFACE AT OPERATION WIGWAM, WITH DOSE RATE CONTOUR LINES THROUGH D + 4 DAYS. Kehrer, W. S. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 28, 1966. 59p.

Aerial survey was utilized to measure the radiation intensities above the contaminated pool at Operation Wigwam. These field data were used to provide a detailed analysis of the radiation field at 3 ft. above the surface through D + 4 days, and to determine the hazard to personnel on board ships traversing the area. The radioactively contaminated surface area inside the 50 mr/hr dose rate contour line was 5.5 sq. mi. at H + 19 min., 6.1 sq. mi. at H + 1.4 hours, and 3.0 sq. mi. at H + 4.2 hours. The area inside the 0.05 mr/hr dose rate contour line was 10.0 sq. mi. when first measured at H + 4.8 hours. On D + 1 day the area had increased to 16.1 sq. mi. and on D + 2, 3 and 4 days it was 32.9, 39.4, and 41.9 sq. mi. respectively. Dose rate contour lines for the contaminated area at these same time intervals have been developed and the area between contours has been measured. The contour lines at H + 19 min. and H + 1.4 hours show that three radioactively hot spots existed within the contaminated pool. The peak intensity for each spot was about three times the average intensity across the contaminated pool during the survey pass in which each peak intensity was measured. The maximum intensities at 3 ft above the surface were 71 R/hr at H + 19 min. and 3.9 R/hr at H + 1.4 hours. At H + 4.2 hours and on D + 1 day only one peak, with maximum intensities of 320 mR/hr and 105 mR/hr respectively, was evident within the contaminated pool. The results on D + 2 days show two separate contaminated pools with two hot spots in each. The contours on D + 3 and D + 4 days show only one contaminated pool. The measure of the hazard to personnel on board ships traversing the contaminated area was revised downward from that previously reported. An altitude correction factor curve for aerial survey readings taken over water has been developed to replace the theoretical curve that had been used for the previous calculations. The new values for the highest average intensity of an individual survey pass measured during each series across the contaminated pool on D day are 23 R/hr at H + 19 min., 1.9 R/hr at 1.4 hours and 170 mR/hr at H + 4.8 hours. On D + 1 day the highest average intensity was 47 mR/hr and on D + 2 days it was about 8 mR/hr. (auth)

23382 (JPRS-34578) HOW TO PURIFY AND TO DISINFECT WATER WITH THE SIMPLEST MEANS. Vekhov, S. P.; Sokolova, N. F. Translated from pp 1-24 of Kak Ochistit' i Obezzarazit' Vodu s Pomoshch'yu Prosteyshikh Sredstv, Meditsina Publishing House, Moscow, 1965. 21p. (TT-66-31018). CFSTI $1.00 cy, $0.50 mn.

The contamination, protection, and purification of water supplies in the event of mass-attack, which includes nuclear, chemical, and bacteriological forms of weapons, are discussed. Reagents, sorbents, and other materials used for the purification of water are listed. (P.C.H.)

23383 (JPRS-34927) METHODS OF COMBATING RADIOACTIVE POLLUTION. Robev, Stefan. Translated from Priroda, No. 5, 14-17(1965). 8p. (TT-66-31365). CFSTI $1.00 cy, $0.50 mn.

Disposal of increasing accumulations of radioactive materials is discussed. Methods for converting radioactive refuse to the solid state, the most convenient form for safe disposal, are evaluated. Decontamination of food, drinking water, areas, and surfaces is considered. (H.G.D.)

23384 (ORNL-tr-969) RELATIVE BIOLOGICAL EFFECTIVENESS OF BETA DOSES ON THE SKIN COMPARED TO GAMMA DOSES ON THE WHOLE BODY. IN THE CASE OF CONTAMINATION OF THE TERRAIN, ON ONE HAND, AND IN THE CASE OF CONTAMINATION OF CLOTHING, ON THE OTHER. Pretre, S. Translated for Oak Ridge National Lab., Tenn., from Bull. ABC, No. 7. Apr. 1965. 11p. Dep. mn. JCL $1.60 fs, $0.83 mf.

The relative biological effectiveness of β particles on the skin and whole-body γ radiation were compared. The terrain was assumed to be uniformly contaminated by a mixture of fission products such as that found after a nuclear explosion. Using the criteria presented, it was concluded that β particles from the terrain were of approximately one order of magnitude smaller than the γ radiation from the terrain; the β dose from clothing uniformly contaminated by a mixture of fission products was approximately one order of magnitude greater than the γ radiation from the clothing; and the radiation dose due to clothing was of the same order of biological effectiveness as that due to the terrain. (C.H.)

23385 (ORNL-tr-970) A RULE OF THUMB. Pretre, S. Translated for Oak Ridge National Lab., Tenn., from Bull. ABC, No. 4. Aug. 1964. 6p. Dep. mn. JCL $1.00 fs, $0.50 mf.

A rule is given for determining the most favorable time to leave fallout shelters after a nuclear explosion. (M.O.W.)

23386 (ORNL-tr-971) RADIOACTIVITY SIMULATOR. Pretre, S. Translated for Oak Ridge National Lab., Tenn., from Bull. ABC, No. 3. Sept. 1963. 14p. Dep. mn. JCL $1.60 fs, $0.80 mf.

A radioactivity simulator was developed for training personnel and troops in exercises and maneuvers where radioactivity is present. It also can be used for the creation of situations in exercises that force commanders to take the consequences of radioactivity into consideration in evaluating their position. In the simulation of a low-yield surface explosion, the contaminated zone can have a length of 50–60 km and a width of 20–30 km. (P.C.H.)

23387 DOSIMETRY OF BETA AND GAMMA RADIATION-EMITTING ISOTOPES ADMINISTERED INTERNALLY. Greenfield, M. A. Acta Iber. Radiol.-Cancerol., 20: 149-52(Apr.-June 1965). (In Spanish).

Determining the radiation dose received by organs by calculating the energy absorbed by the tissue due to the presence of the isotope is considered. It is assumed that all the energy evolving from the β particle is essentially absorbed at the point where the β-radiation-emitting isotope is located. The average energy of the β spectrum is considered along with the isotope concentration, density of the tissue, and appropriate coefficients in order to arrive at the total dose. The β dose depends on the isotope, its concentration in the tissue, and effective half life, but not on the size of the organ. In general, a γ-emitting isotope is able to give a dose to a tissue segment that may be relatively distant from the point of location of the isotope. By using appropriate constants and decay factors, according to elements used, and taking into consideration the size and volume factors, the total γ dose can be calculated. Equations are provided for calculating β and γ doses under various conditions. (TCO)

23388 RADIATION PROTECTION AT NUCLEAR POWER PLANTS. Fendler, Heinz Gerhard. At. Strom, 12: 1-8(Jan.-Feb. 1966). (In German).

The functions of a radioprotection and radiochemical group at a nuclear power installation are outlined. Methods used for the measurement of dose output and activities are described. A survey of the precautions made in the operation of the research installation of Kahl with respect to the radiation doses produced, the activity of waste air and waste water, and the environs monitoring is given. (tr-auth)

23389 DECONTAMINATION OF THE HEAVY WATER SYSTEM OF THE RA REACTOR. Maksimovich, Z. B.; Nassonov, P. M.; Nikolich, R. M.; Marinkovich, M. D.; Elich, L. M. Bull. Boris Kidrich Inst. Nucl. Sci., 16: 251-63(Oct. 1965). (In Russian).

The heavy water system of the RA reactor was decontaminated by separating out ^{60}Co. The solution used for decontamination was 7% H_3PO_4 and 3% CrO_3. The decontamination factor ranged from 10 to 100. From the results the distribution of ^{60}Co in heavy water, and on stainless and aluminum parts was determined. (auth)

23390 RADIONUCLIDES IN FOOD. Bird, P. M. (Dept. of National Health and Welfare, Ottawa). Can. Med. Ass. J., 94: 590-7(Mar. 19, 1966).

Levels of strontium-90 and cesium-137 in Canadian milk during the period 1960–1964 were consistently higher than those in the United States or the United Kingdom, but levels in humans, while also higher, did not reflect the differences observed in milk. Annual dose rates of 27 millirads to bone and 4 millirads to the whole body correspond to the highest average concentrations of strontium-90 and cesium-137 so far observed. Levels of cesium-137 in the urine of residents of the Canadian North were found to increase with the increasing consumption of caribou or reindeer. Whole body counting of a few northern residents showed cesium-137 levels as high as 1000 nanocuries. It is concluded that protective actions are not needed but that studies in the North should be emphasized to provide a better basis for evaluating that particular situation. (auth)

23391 THE RADIATION EXPOSURE OF PATIENTS IN EXTRAORAL AND PANORAMA X RAYS ON TEETH AND JAWS. Sonnabend, Eberhard; Kruse, Dietrich (Univ., Goettingen, Ger.). Deut. Zahnaerztl. Z., 19: 729-52(1964). (In German).

During extraoral x-ray examination of the jaws and skull the radiation dose was measured at the eye, cheek, neck, occiput, in the mouth, and in the region of the gonads of patients. Measurements made in order to determine the skin surface dose were conducted both physically with ionization chambers and chemically by means of film dosimetry. Determination of the gonad dose, by measurements in the lap, could be made only physically with argon high-pressure chambers in view of the very small doses. Among the equipment examined were x-ray devices with rotating anode tubes and variable exposure conditions usually used in the clinic and a half-wave apparatus with stable milliampere values and fixed voltage, used in the general dental practice. Furthermore, two new types of x-ray apparatuses were examined, which make it possible to show the dentures in both jaws with only one or two radiographs, and which should be considered because of their very small dose values. The dose values determined were critically compared with the previous results. It was concluded that when all protective measures are utilized, the dose can be reduced on an average by 80%. (TCO)

23392 RADIOACTIVITY OF A SERIES OF AQUATIC AND TERRESTRIAL ORGANISMS IN RELATION TO RADIOACTIVITY IN THEIR AMBIENT MEDIUM. Wlodek, Stanislaw (Central Lab. for Protection Against Ionizing Radiation, Warsaw). Ekol. Pol., Ser. A, 12: 415-27 (1964). (In French).

The radioactivity of sea water and soil of maritime terrain between Poland and South America was undifferentiated and at a slightly elevated level in the second half of 1962. Soil radioactivity ranged from 9 to 54 pC/g in Europe, and from 2 to 26 pC/g in South America. Zooplankton ash (Crustacea, mainly Copepoda) shows an accumulation 2 to 49 times greater than the surrounding water. About 50% of the samples had only natural radioactivity, with no artificial contamination. Accumulation coefficients for continental plants were determined from

β activity from 50 to 1510 pC/g dry weight in Europe and from 12 to 215 pC/g in South America. Definition of accumulation coefficient is discussed. The coefficient appears to increase with increasing activity. Certain plants have high coefficients and may thus serve as bio-indicators: Achillea millefolium, Tussilago farfara, Matricaria chamomilla, Polygonum dumetorum, Carduus acanthoides, Urtica urens, Dactylis glomerata, Poa annua, and Chenopodium album. (BBB)

23393 RADIATION MONITORING FOR NUCLEAR POWER STATION. **Ind. Electron., 4: 89(Feb. 1966).**

The γ-radiation monitors to be installed in the nuclear power station at Oldbury-on-Severn (United Kingdom) are described. Nineteen channels of area γ-monitoring equipment are required. The γ monitors are comprised of wall-mounted main units that indicate radiation levels and separate detector units consisting of ionization chambers, each with a logarithmic d-c amplifier bolted directly to the chamber casing. The equipment is transistorized except for an electrometer tube input stage, and the main units contain low-voltage power supplies, an ionization-chamber polarizing voltage supply, alarm circuits, indicator lamps, and meters, with most of their electronic components being mounted on plug-in printed-circuit boards. The normal polarizing potential is 100 v d-c, which is adequate for saturation at dose rates up to 10 rem/hr, with a max permissible voltage for other applications of 3000 v. (TCO)

23394 DETECTION OF ERRORS IN MEASUREMENTS ON SOFT X RAYS. **Van Caneghem, P.; Mattelaer, G.; Dunjic, A. J. Belge Radiol., 49: 41-6(1966). (In French).**

Methods using ionization chambers are described for determining sources of error in x-ray dosimetry. (H.G.D.)

23395 SURFACE COATINGS IN ATOMIC ENERGY INSTALLATIONS. **Wells, H. (Atomic Energy Research Establishment, Harwell, Eng.). J. Oil Colour Chem. Ass., 48: 76-86(1965).**

Paints and other protective surface coatings used in atomic energy installations are discussed under three headings: surface coating for contaminated areas, surface coatings exposed to high level radiation, and surface coatings complying to so-called metal-free and clean conditions. Reasons for applying decontaminable coatings are stated, information is given on the types of contamination that can exist, and postulations are made on the mechanisms of contamination. Certain types of surface coatings that have shown excellent resistance to contamination are mentioned. The effects of high-level radiation on surface coatings are considered. The use of suitable pigments and chlorinated rubber bases in paints is discussed. The importance of solvent balance in paint production is also mentioned; an unfavorable balance leading to high solvent retention impairs the ease of decontamination. Changes in plasticizer, stabilizer, and to a certain extent solvent, where this is retained, may equally affect the behavior of the paint film under radiation. Radiation damage only occurs after a paint film is subjected to a very high amount of radiation, above 1×10^8 rad. Plasticizers may exert a protective influence in paint formulations; thus chlorinated diphenyl plasticizers used, for example, in chlorinated rubber can raise the level at which radiation effect occurs, to 1 to 2×10^8 rad. In general, aromatic curing agents confer greater radiation stability on epoxides than the aliphatic types. This can be utilized more in stoving epoxides than in the conventional air-drying types, but certain solventless epoxide coatings utilize aromatic amines as curing agents. In areas where radiation exposure is great, conventional cold-catalyzed epoxide resins are mainly used. These combine reasonable contamination and corrosion resistance with good radiation resistance. Radiation tends to further cure the paint film by formation of free radicals and the overall energy transmitted to the system. Metal-free paints are also discussed. (BBB)

23396 NUCLEAR SUBMARINE AND MARINE CONTAMINATION. **Miyake, Yasuo (Tokyo Kyoiku Univ); Hiyama, Yoshio Kagaku (Tokyo), 33: 492-5(Sept. 1963). (In Japanese).**

Marine contamination and the effects on marine organisms due to radioactive wastes from nuclear submarines and ships are studied by considering the disposal of two kinds of waste: the ion exchange resins used to decontaminate the primary coolant water and the radioactive materials released to the primary coolant during engine warmup. (TCO)

23397 NATIONAL FIRE CODES. VOLUME 9. OCCUPANCY STANDARDS AND PROCESS HAZARDS. **Nat. Fire Codes, 9: 683p.(1965 66).**

Selected National Fire Protection Association standards and manuals on occupancies and process hazards related to marine, aviation, and ground transportation and including some occupancy and process hazards associated with these three forms of transportation are presented. Separate abstracts were prepared on the sections on handling radioactive materials and fire protection practices for nuclear reactors. (C.H.)

23398 RECOMMENDED SAFE PRACTICE FOR LABORATORIES HANDLING RADIOACTIVE MATERIALS. **Nat. Fire Codes, 9: 801.1-41(1965-66).**

Safe practices for fire protection in laboratories handling small quantities of radioactive material are presented. (C.H.)

23399 RECOMMENDED FIRE PROTECTION PRACTICE FOR NUCLEAR REACTORS. **Nat. Fire Codes, 9: 802.1-71(1965-66).**

Fire protection practices for nuclear reactors recommended by the National Fire Protection Association are presented. (C.H.)

23400 RADIATION CONTROL IN ENTERPRISES. THE CASE OF THE TOKAI REFINERY OF JAPAN ATOMIC FUEL CORPORATION. **Maruyama, Masamichi. Nuclear Eng. (Tokyo), 11: 65-74; 79(Mar. 1965). (In Japanese).**

The production of uranium, i.e., refinery of uranium ores, and research on refining methods are conducted at the Tokai Refinery. Safety control there is centered on protection against radiation. The operations of the refinery are on industrial scale, the amount of radioactive substances being far larger that in any other enterprise in Japan. Thus the control of internal exposure from uranium taken in the body is most important. For this reason strict monitoring is carried out. Radiation control is divided into personnel protection and protection of the surrounding populace. For personnel health control, both periodic and special medical checks and blood and urine examinations are made. (NSA of Japan)

23401 UKN 1—A DEVICE FOR THE CONTROL OF CONTAMINATED FOOT-WEAR. **Dimic, Miroljub (Inst. Ruder Boskovic, Vinci, Yugoslovakia). Nukl. Energ., No. 5-6, 34-6(1965). (In Slovak).**

An assembly measuring footwear contamination by gamma and beta activities, with energies higher than 10 kev or 0.3 Mev with automatically compensated background activity, is described. The measuring range is up to 10,000 imp/min, and can be extended. (auth)

23402 AN UNCONFINED, LARGE-VOLUME HYDROGEN/AIR EXPLOSION. **Reider, Roy (Los Alamos Scientific Lab., N. Mex.); Otway, Harry J.; Knight, Herbert T. Pyrodynamics, 2: 249-61(May 1965).**

An experiment was conducted to measure the acoustic levels in a test cell area during release of hydrogen at high flow rates (~120 lb/sec). Normally any hydrogen discharge at a flow rate greater than one lb/sec is flared; however, for this experiment, it was necessary to flow once with the hydrogen flared and once without burning, in an attempt to isolate the effect of combustion on these acoustic fields. An average flow rate of 120 lb/sec for ten sec was achieved, and three sec after shutdown began the gas autoignited. The resulting phenomenon was described as a deflagration of explosive rapidity. A shock wave of about sonic velocity occurred. Superficial damage to light buildings within a few hundred feet was documented by photography. These photographs showed damage caused more from the negative phase of the shock wave than from the positive. It appeared

that the amplitude of the negative phase was about equal to the positive phase, but as these amplitudes were a fraction of a psi and the buildings were designed for 100 mi/hr winds, the buildings more readily withstood the positive shock wave. The overpressure was estimated at about 0.5 psi and the amplitude of the negative phase at about 0.25 psi. The possibility of so-called molecular collapse was considered; that is, where the water product of the hydrogen oxidation was more dense than hydrogen itself, the volume of combustible products was caused to shrink rapidly, thus creating the high negative phase. However, this was discounted because of the presence of large quantities of nitrogen. Of ~2000 lb of unburned hydrogen exhausted during this run, only about 200 lb contributed to the explosion. This may indicate that there is no great problem in exhausting a large quantity of hydrogen into the atmosphere. In the case described a large percentage of the hydrogen exhausted was too diluted to participate in the explosion. A factor here was the high discharge velocity of the hydrogen (4000 ft/sec at the flow rate of 120 lb/sec), which probably aided considerably in the dilution process. (BBB)

23403 RADIATION PROTECTION IN LAWS, REGULATIONS, AND INSTRUCTIONS. **Seelentag, Walter (Bundesgesundheitsamt, Berlin). Radiologe, 4: 349-55 (Nov. 1964). (In German).**

Radiation protection standards effective in Germany are reviewed historically. The significance of various rules and regulations in the medical and industrial accident and safety fields is discussed. Guidelines that have been provided by international organizations, legal regulation of radiation protection in nonmedical and medical fields, and the fundamental considerations that affect modern radiation protection procedures are considered. The permissible individual radiation doses for occupationally exposed persons and entire populations are outlined briefly. (TCO)

23404 DOSIMETRY IN DISASTERS AND WAR. **Wachsmann, F.; Kimberger, F. (Univ., Erlangen-Nuremberg, Ger.). Radiologe, 4: 372-4(Nov. 1964). (In German).**

The purposes and methods of radiation dosimetry in disasters and thermonuclear war are discussed. The upper and lower limits of measurement are outlined. The purposes of dosimetry in these cases are to determine the permissible occupation time for a given area, measurement of individual doses to ascertain what measures should be taken to minimize subsequent irradiation injuries, and the operational capabilities of irradiated personnel. The dose of irradiation that is considered tolerable in disasters has been estimated as 12.5 rem so that for each 40-hr week the measurable dose should be ~310 mrem/hr. Advantages of film dosimeters are compared with those of glass dosimeters. (TCO)

23405 ENVIRONMENTAL MONITORING IN THE AREA OF THE CADARACHE NUCLEAR STUDIES CENTRE. **Candes, P.; Grandin, F. (Cadarache Nuclear Studies Centre, France). pp 23-9 of STI-PUB-98.**

The environmental monitoring program for the Cadarache Center in France for atmosphere, water, and vegetation is described. Hydrology, meteorology, and human geography of the site is also discussed. Hazards associated with normal operation of the establishment are listed. In the atmosphere, measurements are made of gamma irradiation and of β and α contamination by aerosols and gases. Special attention is given to U, Th, ^{90}Sr, and ^{137}Cs in water, and total β activity and the activity of ^{89}Sr, ^{90}Sr, and ^{137}Cs are determined in vegetation. (P.C.H.)

23406 ENVIRONMENTAL MONITORING AROUND THE NUCLEAR RESEARCH CENTRE AT LA CASACCIA, ITALY. **Tagliati, S.; Ilari, O. (Casaccia Centre for Nuclear Studies, Italy). pp 30-44 of STI-PUB-98.**

The geological characteristics, meteorology, location, and sources of radioactive waste materials at the Nuclear Research Center, La Casaccia, Italy, are described. The environmental monitoring procedures for inside and outside the Center are listed for fallout, grass, atmosphere, milk and fodder, and surface water. (P.C.H.)

23407 ENVIRONMENTAL MONITORING AROUND THE NUCLEAR POWER STATION AT CHAPELCROSS, ANNAN, SCOTLAND. **Martin, J. H. (Chapelcross Works, Scotland). pp 45-54 of STI-PUB-98.**

Sources of radioactive wastes and the environmental monitoring program at Chapelcross, Annan, Scotland, are described. Results for the measurement of ^{131}I and ^{90}Sr in milk are reported. (P.C.H.)

23408 ENVIRONMENTAL MONITORING AROUND A LONG-TERM STORAGE PLACE FOR SOLID RADIOACTIVE WASTES IN CZECHOSLOVAKIA. **Kortus, J. (Chemoprojekt, Prague). pp 55-62 of STI-PUB-98.**

Experience in operating the central radioactive waste storage facility in Czechoslovakia and the procedures and equipment used for environmental control are described. (P.C.H.)

23409 ENVIRONMENTAL MONITORING AROUND A URANIUM MILL IN THE UNITED STATES OF AMERICA. **Tsivoglou, E. C. (Robert A. Taft Sanitary Engineering Center, [Cincinnati,] Ohio). pp 63-70 of STI-PUB-98.**

An environmental monitoring program is described that illustrates the combined effects upon a river environment of waste-disposal operations from an operating uranium mill, and the residual effects from an abandoned uranium mill located approximately 15 miles upstream. The area described is located in the southwestern United States in the State of Colorado. Water samples are analyzed primarily for dissolved ^{226}Ra and U. (P.C.H.)

23410 I. F. A.-CLUJ CONTRIBUTIONS TO THE STUDY OF ENVIRONMENTAL RADIOACTIVITY IN THE LAST 15 YEARS. **Szabo, A. Stud. Cercet. Fiz., 16: 1091-1115 (1964).**

Methods used for the determination of environmental radioactivity from both natural sources and fallout are described. Results of measurements of natural radioactivity in waters, natural gas, therapeutic muds, and rocks in Rumania carried out since 1964 are summarized. Data on environmental radioactivity due to fallout, collected from 1960 through 1964, showed a steady decrease in radioactivity following the cessation of nuclear tests. (C.H.)

23411 RADIOACTIVE CONTAMINATION OF (DUTCH) FOOD, 1964. **Haken, J. W. Voeding, 26: 525-33(Sept. 15, 1965). (In Dutch).**

Data are given on the ^{90}Sr and ^{137}Cs content of rain water and food in Holland in 1964. A semi-continuous survey of milk, bread, and meat, and some 80 analyses of vegetables and various food items are included. The values are expressed in pC/l and mC/km^2 for rain water, pC/kg and pC/g for ^{90}Sr in food, and pC/kg for ^{137}Cs in food. (TCO)

23412 UMWELTRADIOAKTIVITAET UND STRAHLENBELASTUNG. **Bericht I/65. (Environmental Radioactivity and Radiation Burden. First Quarterly Report, 65). Bad Godesberg, Ger., Bundesminister fuer Wissenschaftliche Forschung, 1965. 201p. DM 8.--.**

The content of the radioactive material in air, water, soil, and food materials, and the radiation burden of the population in the German Federal Republic, measured during the first quarter in 1965 were reported in graphic and tabular form. (J.S.R.)

23413 UMWELTRADIOAKTIVITAET UND STRAHLENBELASTUNG. **Bericht III/65. (Environmental Radioactivity and Radiation Burden. Third Quarterly Report, 65). Bad Godesberg, Ger., Bundesminister fuer Wissenschaftliche Forschung, 1965. 203p. DM 10.--.**

The content of the radioactive materials in air, water, soil, and food materials and the radiation burden of the polulation in the German Federal Republic measured during the third quarter during 1965 are reported in graphic and tabular form. (J.S.R.)

23414 DOSIMETRIE ZUR BETATRONTHERAPIE. **(Dosimetry in Betatron Therapy). Pohlit, Wolfgang. Stuttgart, George Thieme Verlag, 1965. 85p. DM 24,--. Intercontinental Medical Book Corp., New York.**

The dosimetry method in betatron therapy developed at the Siemens-Reiniger-Werke, in cooperation with the Max Planck Institute for Biophysics is described in detail. The measurement on the radiation source, measure-

ments on the electron beam, measurements on the photon beam, absolute determination of the dose, clinical dosimetry, and radiation protection at the betatron are considered. (J.S.R.)

23415 MITTEL UND METHODEN DES SCHUTZES GEGEN MASSENVERNICHTUNGSMITTEL. TEIL I. KERNWAFFENWIRKUNGEN UND SCHUTZMOEGLICHKEITEN. (Means and Methods of Protection Against Mass Destruction. Part I. Nuclear War Effect and Protection Possibilities). Langhans, Anita. Berlin, Deutscher Militaerverlag, 1965. 158p.

The essential nuclear physical fundamentals of radiological warfare are reviewed and the types of nuclear weapons are discussed. The capabilities necessary for each type of weapon are briefly indicated. The concept of protection is then discussed. The possibilities for protection against effects of the pressure wave, the light radiation, and the nuclear radiation are discussed in some detail. The possibilities of protection against radioactive chemical warfare agents and non-radioactive chemical warfare agents are also discussed. (J.S.R.)

23416 COLLECTED PROBLEMS ON THE DOSIMETRY OF, AND PROTECTION FROM, IONIZING RADIATION. Ivanov, V. I.; Konstantinov, I. E.; Maskovic, V. P. Moscow-Centr, Atomizdat, 1964. 134p. 0.40 Roubles.

Some 400 practical problems to be worked out on basic principles of radiation dosimetry and radiation protection are presented. The solutions are given in a key in the appendix. The problems cover the basic physical principles, radiation dosimetry, and radiation protection. A substantial amount of data is appended, including measurement constants and units, gamma radiation characteristics of various radioactive isotopes, as well as various coefficients, spectra, etc., tables for the calculation of shielding, nomograms, and so on. (auth)

23417 RADIATSIONNAYA BEZOPASNOST' PRI KOSMICHESKIKH POLETAKH. (Radiation Safety in Cosmic Flights). Bobkov, V. G.; Demin, V. P.; Keirim-Markus, I. B.; Kovalev, E. E.; Larichev, A. V.; Sakovich, V. A.; Smirennyi, L. N.; Sychkov, M. A. Moscow, Atomizdat, 1964. 371p.

Special problems involved in the dosimetry of cosmic radiation are considered. The energy spectra and spatial distributions of radiation in space, including primary (galactic) and solar cosmic radiation and radiation of the internal and external radiation belts, are described, and the calculation and measurement of doses from them are discussed. Interactions of high-energy protons with shielding material are summarized, and the calculation of shielding for space ships from protons of the internal radiation belt and solar flares and from electrons and bremsstrahlung of the external radiation belt is discussed. Types of nuclear energy sources used on cosmic devices are described, and the shielding of reactors on board space ships is considered. (M.J.T.)

23418 RAGGI X. PROTEZIONE, DOSIMETRIA, PREVENZIONE. (X Rays. Protection, Dosimetry, Shielding). Venier, A. [Rome], Ente Nazionale Prevenzione Infortuni, 1964. 296p.

An outline is given of the characteristics, production, and effects of x radiation. The topics discussed are: the design and operation of x-ray machines, attenuation and measurement, the effects of ionizing radiation on living matter, maximum permissible dose, physical monitoring of radiation, medical monitoring, personnel accessories for protection against x radiation, medical and industrial protection and prevention standards. (J.S.R.)

INSTRUMENTATION

General

Refer also to abstract 22858.

23419 (AD-626405) BIBLIOGRAPHY OF ARRAY LITERATURE. (Teledyne Industries, Inc., Garland, Tex. Geotech Div.). Nov. 9, 1965. Contract AF33(657)-12145. 52p. (TR-65-114). CFSTI $3.00 cy, $0.50 mn.

A bibliography of available literature on array technology was compiled, embracing the disciplines of seismology, acoustics, and radio. Over one hundred articles from various scientific journals are listed. Most of the articles are abstracted and are grouped according to a major category, Field of Application, and a subcategory, Character of Content. The majority of the articles were published during the period 1955-1956. (auth)

23420 (ANL-7108, pp 57-60) MASS SPECTROMETER WITH PHOTOIONIZATION SOURCE. Berkowitz, J.; Chupka, W. A. (Argonne National Lab., Ill.).

A mass spectrometer using a photoionization source was developed and was used to study the photoionization of butane, ethane, and propane. Ion-pair production of the type $C_nH_{2n+2} + h\nu \rightarrow C_nH_{2n+1}^+ + H^-$ was observed for all three hydrocarbons. (D.C.W.)

23421 (LNF-66/2) CRIOSTATO PER BERSAGLI DI DEUTERIO SOLIDO. (Cryostat for Solid Deuterium Targets). Note No. 303. Cecchini, A.; Modena, I. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Jan. 24, 1966. 10p. Dep. mn.

The design and performance of a cryostat for solid deuterium targets to be used in plasma studies are described in some detail. Cross sections of the cryostat show the simplicity of its operation. (J.S.R.)

23422 (N-65-33177) TWO-COMPONENT MICROBALANCE FOR MEASURING THE FORCES ON ION-BOMBARDED SURFACES. Rogallo, Vernon L.; Savage, Howard F. (National Aeronautics and Space Administration, Moffett Field, Calif. Ames Research Center). [1965]. 14p. (NASA-TM-X-56772). CFSTI $1.00 cy, $0.50 mn.

A two-component null-type microbalance was developed to measure forces due to ion bombardment on a surface. The balance employs the principle of the attracted-disk electrometer. The sensitivity can be adjusted by simply changing the location of the center of gravity. Measurements of a few micrograms of force in two perpendicular directions can be made simultaneously. (STAR)

23423 (RISO-M-313) BERETNING OM ARBEJDET I ELEKTRONIKAFDELINGEN I TIDEN 1, APRIL TIL 30. JUNI 1965. (Quarterly Report of The Electronics Department for the Period April 1-June 30, 1965). (Danish Atomic Energy Commission, Risoe. Research Establishment). Sept. 1965. 62p. Dep. mn.

The development progress made in the PBP 8 computer system, 7 V experiment counting equipment for research installations, punched tape reader unit, instrumentation for loop studies for heavy water fuel plates in the DR-3 reactor, counting instrumentation for irradiation research, electrometers for logarithmic amplifier elements, beam sweep generators, redundancy principle for logical elements, block diagrams of electron tubes, dimensions of electron tubes, dimensioning of numerical control systems, and transistorized electrometer amplifier are reported. (J.S.R.)

23424 (RISO-M-351) BERETNING OM ARBEJDET I ELEKTRONIKAFDELINGEN I TIDEN 1 JULI TIL 30 SEPTEMBER 1965. (Quarterly Report of the Electronics Department for the Period July 1-September 30, 1965). (Danish Atomic Energy Commission, Risoe. Research Establishment). Dec. 1965. 18p. Dep. mn.

Work is reported on numerical control of mechanical motions, a bridge for measuring chemical concentrations, testing of a β-current neutron detector, prospecting for beryllium currencies in Greenland, determination of the activity of plane circular γ source, transport delay with low readout systems and modifications on a chopper-stabilized operational amplifier. (J.S.R.)

23425 (SC-R-65-992) THE TRANSMISSION AND RECEPTION PROPERTIES OF AN EQUATORIAL SLOT ANTENNA ON A RE-ENTRY SPHERE. Harrison, Charles W. Jr.; Taylor, Clayborne D. (Sandia Corp., Albuquerque, N. Mex.). Nov. 1965. Contract AT(29-1)-789. 57p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

The re-entry vehicle model employed in this study consists of a plasma clad sphere with a narrow circumferential slot cut at the equator. The slot is excited by a biconical transmission line driven at its center by a coaxial cable. The homogeneous plasma may be in contact with the sphere or an insulating barrier interposed between the sphere and the plasma sheath. The driving point impedance referred to the input terminals and the radiation field in terms of the input current are determined. The efficiency of transmission is calculated by taking the ratio of the power obtained by integrating the Poynting vector over the surface of a great sphere to the power supplied the linearly tapered radial transmission line by the coaxial cable. The voltage appearing across an impedance connected to the terminals of the biconical transmission line is evaluated in terms of the amplitude of an incident plane wave electromagnetic field. Extensive numerical results are presented exhibiting the transmission and reception qualities of the equatorial slot antenna on the re-entry sphere, when the plasma is in contact with the vehicle, for a range of frequencies and plasma properties. (auth)

23426 (TID-20893(Rev.)) STANDARD NUCLEAR INSTRUMENT MODULES. Adopted by AEC Committee on Nuclear Instrument Modules. Costrell, Louis (National Bureau of Standards, Washington, D. C.). Jan. 1966. 21p. Dep. mn. GPO $0.20.

Specifications for standard nuclear instrument modules and bins and for power supplies are presented. A listing of specification drawings is included. (D.C.W.)

23427 (UCRL-16580, pp 219-50) INSTRUMENTATION. (Lawrence Radiation Lab., Univ. of California, Berkeley).

Research and development devoted to the 88-inch cyclotron are summarized. Research progress is also reported on Pu^{3+} interactions with $LaCl_3$, radiation detector amplifiers, nuclear instruments, analog-to-digital converters, instruments for modular systems, Ge gamma detectors, beam current integrators, data processing equipment, Si radiation detectors, detection of protons at 30 and 40 Mev, computers for nuclear spectroscopy, advanced multiscalers, bubble meters for gas flow, electron-gamma angular correlation equipment, three-counter particle identifiers, use of Ge detectors in activation analysis of sulfide ores, mica track scanners, and internal conversion spectrometers. Development of magnetic-field correction system for iron-free beta spectrometers is reported along with research on varying magnetic fields for use in beta spectrometers. (J.R.D.)

23428 (AEC-tr-6466/1, pp 127-30) RAPID-ACTION FIRE-ALARM (SIGNALING) UNIT. Zhdanov, Makarov. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A fire-alarm unit that uses an ionization chamber and a radiation source is described. The unit is based upon the effect of combustion products (smoke) on the ionization current. (D.C.W.)

23429 (AEC-tr-6466/1, pp 142-9) METHODS FOR THE COMPARATIVE TESTING OF RADIOACTIVITY RE-

LAYS, AND THE TERMINOLOGY OF THE BASIC PARAMETERS INVOLVED. Vasil'ev, A. G.; Klempner, K. S. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The terminology and symbols recommended for use in drafting technical specifications for the comparative testing of radiation-actuated relay-action instruments and systems are summarized, together with some methods of comparative testing of relays containing radiation sources. (G.O.Y.)

23430 (AEC-tr-6466/1, pp 150-7) TECHNICAL SPECIFICATIONS FOR COLD-CATHODE TUBES. Korablev, L. N. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The minimum number of parameters that should be specified in the manufacture of cold-cathode tubes is established, and the basic parameters and tolerances of the cold-cathode triodes and tetrodes that are currently produced in the Soviet Union are tabulated. (D.C.W.)

23431 (AEC-tr-6466/1, pp 245-8) RADIATION TRANSDUCER FOR THE CONTINUOUS MEASUREMENT OF SMALL VARIATIONS IN THE CONCENTRATION OF LIQUID SOLUTIONS. Borukhov, M. Yu.; Ivashev, V. Ts.; Kleimenov, V. F. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A transducer for detecting small concentration variations and automatic temperature correction is described. The transducer is an aerometer-thermometer combination with a floating radiation source on the surface of the thermometric liquid. (G.O.Y.)

23432 (AEC-tr-6466/1, pp 249-55) PROSPECTS OF INTRODUCING RADIATION-DENSITY GAGES INTO THE ORGANIC-SYNTHESIS INDUSTRY. Experience in Testing and Practical Application. Veksler, M. A.; Furman, K. S.; Mukhin, G. A. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The results of tests of a radiometric density gage containing halogen-quenched Geiger counters are presented. The tests were performed with aqueous solutions of $CaCl_3$ and $ZnCl_2$ and with CCl_4. (G.O.Y.)

23433 OPERATING CHARACTERISTICS IN A LOW-INDUCTANCE FLASH X-RAY SYSTEM. Haendel, S. K. (Uppsala Univ.). Ark. Fys., 28: 303-16(1965).

The operating characteristics—current, dI/dt, and x-ray production versus time—of a low inductance flash x-ray system were recorded oscillographically and the oscillograms obtained show that it is possible to distinguish between two different phases in the flash x-ray discharge: first, one during which a plasma emanating from the anode moves in a direction towards the cathode so that a plasma column is formed between the flash tube electrodes. During this first phase x rays are emitted in a burst of about 2–3 μsec duration; second, another phase characterized by high current, about 30 kamp peak current at 15 kv initial capacitor voltage, and emission of x rays during intervals of about 100 nsec duration. The production of these x-ray bursts occurs when the discharge current decreases. The x radiation produced during the first phase is easily cut off by means of a 2.5 mm Al-filter so that only the 100 nsec bursts are detected. At 20 kv initial voltage these bursts are hardly influenced by the presence of a filter of 2-mm Pb and 2.5-mm Al. These hard x-ray bursts are, as a discussion of the discharge mechanism indicates, caused by accelerating voltages set up when the pinch effect acts on the discharge plasma column. (auth)

23434 HIGH VACUUM MEASUREMENT BY MEANS OF VIRTUAL CATHODE RELAXATION TIME. Lloyd, O. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Brit. J. Appl. Phys., 17: 357-70(Mar. 1966).

The theory of virtual cathode formation in electron beams is reviewed. Destruction of a virtual cathode by the accumulation of residual gas ions is shown to occur in a time which is inversely proportional to the pressure. This forms the basis of a method of measuring low pressures which may have some advantages over conventional ionization gages, especially in the presence of high magnetic fields. Experimental results are presented where this effect is used to measure pressures in the range $10^{-4}-4\times10^{-9}$ torr. (auth)

23435 PRESENT POSSIBILITIES AND OUTLOOK OF FAST ELECTRONICS. Mey, J. Bull. Inform. Sci. Tech. (Paris), No. 99, 5-19(Dec. 1965). (In French).

A survey of the most significant results recently obtained in the field of fast nuclear electronics is given. It emphasizes the important part played by the "snap-off diode". It shows how technical progress allowed to improve, not only the speed of the circuits, but, particularly the reliability, the versatility and the ease of use. An attempt is made to investigate those techniques which seem capable of leading to a faster instrumentation. (auth)

23436 GRAPHICAL DETERMINATION OF THE PATH OF THE ION BEAM FROM A HIGH-FREQUENCY ION SOURCE MODEL. Oezkoek, S.; Yaramis, B. (Univ. of Istanbul). Istanbul Univ., Fen. Fak. Mecmuasi, Seri C, 30: 33-7(Jan.-Apr. 1965).

The focusing action of electrostatic lenses using the graphical method was investigated. The equipotential surfaces are drawn on rheographic paper and the path of the ions beam emerging from the radio-frequency ion source is determined by applying the Snell's law of refraction successively. Two lenses were enough for the focusing. The ratio of the dimensions of the extraction channel is l/d = 8 and the ratio of the inner diameters of the first and second electrodes are $D_2/D_1 = 2.4$ and $D_4/D_3 = 1.6$ respectively. The d-c potential differences which are applied to the electrodes of both focusing lenses are in the ratio of 1/6. (auth)

23437 ALL SOLID-STATE μμ AMMETER. Kaneko, Eiji (Hitachi Ltd., Tokyo). Nippon Genshiryoku Gakkaishi, 8: 134-40(1966). (In Japanese).

Several design factors of a μμammeter are discussed. The results were utilized in developing an all solid state μμammeter. Representative parameters of the ammeter include: current range, 10^{-12} to 10^{-4} amp; input impedance, 10^8 to 1 ohm; response time, 0.5 sec in 10^{-12} amp range, 50 msec in 10^{-11} amp range, stabilizing time, less than 30 sec for all ranges; overall drift, ±0.1%/8 hr; temperature coefficient, +0.015%/°C at 20°C and ±0.45% for 0 to 60°C; and line stability, ±0.1%/a-c 100v ±29%. (auth)

23438 EXTENSION OF MEASUREMENT POSSIBILITIES IN 256-CHANNEL ANALYZER. Hoffman, Zbigniew; Komor, Zenon; Rydzewski, Tadeusz (Instytut Badan Jadrowych, Swierk, Poland). Nukleonika, 10: 627-33 (1965). (In Polish).

A 256-channel analyzer, originally completed in 1962, has since undergone a series of modifications and improvements, the most important of which are described in this communication. These include the widening of the time channels to 2, 4, 8, 16, 32, or 64 μ seconds; the proper phasing of the analyzer after each event to avoid timing errors for subsequent counts in each cycle; the splitting of analyzer into two halves with the possibility of comparing on an oscilloscope the spectra stored in the two halves; and the capability of delaying the measuring cycle by as much as 15 times the duration for a single cycle.(TTT)

23439 SINGLE CHANNEL PULSE HEIGHT ANALYZER. Mielnicki, J. Andrzej (Instytut Fizyki Jadrowej, Krakow). Nukleonika, 10: 635-6(1965). (In Polish).

The circuit can operate as either a single-channel analyzer or as a direct pulse-height discriminator. It is based on a design found in the literature, but with a number of modifications which give it the following characteristics: an amplitude range of 5-124 v., a measuring dead time of 0.8 μ sec, a 1% nonlinearity, and a stability of 0.2% ± 70 mv per 8 hours. (TTT)

23440 A 100-CHANNEL PULSE AMPLITUDE ANALYZER. Ts'ai, Hsi-sung; Tai, Kuei-liang. Yuan Tzu Neng, No. 3, 205-14(1965).

An improved circuit of a 100-channel pulse amplitude analyzer, widely used in the field of nuclear physics, especially for the measurement of the energy spectrum of a short half-life radiation source and fast neutrons is described. It was discovered that an analyzer built in 1958 and containing 100 channels and a magnetic core storage unit was not very reliable. The present improved circuit has been tested under practical working conditions for two years and the results are satisfactory. The system has four main parts: the input circuit, the storage unit, the control circuit, and the display panel. The signal coming from the measured source is amplified and converted into a pulse train which represents a number proportional to the amplitude of the signal. At the same time, the input circuit prevents any second signal from coming in while the pulse train is being stored in the storage unit. The control circuit functions according to the instructions issued by the input and controls the unit which performs the calculation in the chosen channel and feeds the result back to the storage unit. The display panel then shows the resulting curve, and, if required, the exact value of the results. The circuit is discussed in detail with the help of circuit diagrams. Brief suggestions are given on ways to adjust the device and to test its accuracy. (ATD)

23441 MATTAUCH-HERZOG TYPE MASS SPECTROGRAPH WITH A TWO-STAGE ELECTROSTATIC FIELD. Takeshita, Isao (Matsushita Electric Industrial Co., Osaka). Z. Naturforsch., 21a: 14-25(Jan.-Feb. 1966).

The most important advantage of the Mattauch-Herzog type mass spectrograph is double focusing for all masses. One disadvantage, however, is the fact that the energy slit cannot control the velocity spread (β) independently of beam divergence (α). This disadvantage is removed by substituting a two-stage electrostatic field for the usual single one. General formulas for determining the distances between the elements of the optical system are derived. Combinations of two cylindrical electrostatic fields with equal radii are chosen as a practical example. The condition to be fulfilled for a physically significant solution and the resolving power of this system are discussed. The study of the second-order aberrations shows that α^2 focusing for all masses can be achieved under suitable conditions. In addition, α, β, and β^2 aberrations can be made to vanish simultaneously at a point on the focal plane. The design parameters are numerically computed and tabulated for several favorable examples. The total image defect is calculated for a typical example, and found to be very small for a wide range of masses. (auth)

23442 A NEW MASS SPECTROGRAPH WITH VERY LARGE DISPERSION. Matsuda, H. (Osaka Univ.); Fukumoto, S.; Kuroda, Y.; Nojiri, M. Z. Naturforsch., 21a: 25-33(Jan.-Feb. 1966).

A new type of mass spectrograph with large mass dispersion was constructed. The distinguishing feature of this apparatus is that the mass dispersing action of a r^{-1} magnetic field is utilized. The instrument has a r^{-1} magnetic field of 198.1° sector type (22 cm mean radius) as the dispersing field, a toroidal electric field of 118.7° sector type (30 cm mean radius) and a 30° uniform magnetic field (120 cm mean radius) as the focusing fields. The principle, the design and important parts of the apparatus are described. The dispersion on the photographic plate was estimated to be for 1% mass difference and the maximum resolving power of about 500,000 was obtained. (auth)

23443 THE FILTER LENS AS A MONOCHROMATOR FOR FAST ELECTRONS. Hartl, W. A. M. (Univ., Hamburg). Z. Phys., 191: 487-502(1966). (In German).

The energy width ΔE of thermionically emitted fast electrons (30–50 kev) is reduced by applying an axial symmetrical electrostatic three-electrode lens with a sufficient high chromatic error. It was possible to reach values ΔE of about 12 Mev. The dependence of the energy width ΔE of the lens parameters and the current density were studied. In energy-loss experiments on Al foils with monochromatic electrons one obtains a halfwidth of the 15 ev-loss of 0.9 ev. This is in good agreement with the value determined from the plasma radiation peak and with that deduced from optical data. (auth)

23444 BANDING CAMERA, MODEL 3 (Engineering Materials). (Oak Ridge Gaseous Diffusion Plant, Tenn. Oak Ridge National Lab., Tenn.). (CAPE–1359).

4 drawings.

A camera is described, which photographically records the presence and relative quantity of isopycnic bands in batches of 12 or fewer zonal centrifuge tubes. The film records, in one-quarter size, the tubes and their identification plates, which are arranged side by side. An adjustable timer controls the length of time for each exposure. It can be used in a containment enclosure. The equipment consists of a portrait type camera, front surface mirrors, light pipe system, an adjustable timer, and a light-tight cabinet. The camera is a Rembrant, Model 1 without a shutter. An incandescent bulb ~1 in. in dia and 18 in. long with a 60 w rating is used as the light source. Light pipes are individual methyl methacrylate plastic cylinders shaped to fit the lamp curvature. (For details, see TID-4100.) (M.C.G.)

23445 SEQUENCED VALVE TIMER /Q-2264/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE–1304).

2 drawings.

The valve timer described is used in a device that collects gas samples from the vicinity of an underground nuclear explosion within 10 sec of the detonation. Instrumentation of the sampler provides for firing explosive-actuated valves on seven evacuated sample vessels, recording the firing impulses, and measuring and recording the pressures in the sample vessels. The timing device consists of a 1-kc oscillator, a 4-decade scaler, and silicon-controlled rectifier firing circuits. Timing is accomplished by gating on the oscillator at zero time, counting the output of the oscillator on the scaler, and gating the combinations of each decade to obtain the desired outputs. Firing circuits are identical for each valve. Valve firing currents (~4 amps) pass through individual current transformers to produce pulses for the recorder. (For details, see TID-4100) (F.L.S.)

23446 ELECTRONIC COMPONENTS (Engineering Materials). (Chicago Operations Office (AEC), Ill.). (CAPE–1212).

69 drawings.

Electronic equipment designed in the Elementary Particle Physics Research Laboratory is described. Diagrams are presented for coincidence circuits, gates, standard connections for a 24-pin power connector, scalers, amplifiers, registers, linear stretchers, d-c inverters, a cable delay, and a trigger delay. (M.C.G.)

23447 1965 INTERNATIONAL TELEMETERING CONFERENCE, 18, 19, 20 MAY, 1965, WASHINGTON, D. C., PROCEEDINGS. VOLUME 1. [Pasadena, Calif., F G McGavock Associates], 1965. 812p. (CONF-650566-(Vol.1)).

Separate abstracts were prepared for 2 of the 54 papers presented. (B.G.D.)

For abstracts of individual papers see: 23526 and 24746.

23448 CONTROL DEVICE, USING RADIATION. Ogata, Hideto; Kobayashi, Akira; Aida, Chohei. Japanese Patent 1964-9115. May 12, 1965. Filed Dec. 18, 1961.

A railway signal using radiation and having high reliability and rapid response is described. A radiation detector is installed with the track; a radiation source is installed in the train. Circuits and relays are so arranged that when a train passes over the track and the detector is actuated by the source, a red danger signal is given. A red danger signal is also given when any failure in the system occurs. Thus a green safe signal indicates not only the absence of a train but also that the whole system of signals is functioning properly. (TCO)

23449 DEVICE FOR PRODUCING REACTOR PERIOD SIGNALS. Iwashita, Fumio (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-11220. June 4, 1965. Filed Dec. 19, 1961.

In a device for calibrating a period meter, simulated reactor period signals are produced by electric circuits alone. The device includes an integrating part, including the initial voltage source, d-c amplifier, and negative feedback condenser, a high resistance connected in series to the integrating part, and a d-c source to charge the integrating part through the resistance. On the output side of the d-c amplifier is installed a part to obtain the time-varying voltage of $A \cdot t/T$ (where A is a constant and T is the reactor period). (NSA of Japan)

23450 METHOD OF CONSTRUCTING A SOLAR COLLIMATOR. Seki, Yoshinaga (to Mitsubishi Electric Mfg. Co., Ltd.). Japanese Patent 1964-18456. Aug. 19, 1965. Filed Aug. 25, 1962.

A solar collimator for taking out parallel rays, including neutron and x rays, is made up of radiation absorbing plates, usually steel. These plates are piled parallel with spacers between. The entire unit is held with a framework and nuts and bolts. Since the plates are very thin, they stay flat, but tend to remain under stress. If the plates and frames have different thermal expansion coefficients, the frames having a higher coefficient than the plates, and if the assembly is made at a temperature lower than that at which the collimator is to be used, the difficulty of uneven stretching is eliminated. Also concave cuts are made along sides of the plates to help divide the stretching equally over the length of the plates in the axial direction. (TCO)

Radiation Detection

Refer also to abstracts 22633, 23163, 23335, 23336, 23359–23365, 23367, 23368, 23538, 23542, 23906, 23914, 24314, 24329, 24351, 24363, 24637, and 24716.

23451 (AD–627323) RESEARCH DIRECTED TOWARD THE STUDY OF NUCLEAR RADIATION. Final Report, January 25, 1962–July 24, 1965. Barrett, Theodore B.; Carpenter, Jack W. (American Science and Engineering, Inc., Cambridge, Mass.). Oct. 6, 1965. Contract AF19 (628)-349. 111p. (AFCRL–65-801). CFSTI $4.00 cy, $0.75 mn.

The design and description of the optical system for installation in the KC-135 airborne laboratory of AFCRL are presented. The optical system consists of a 4-barrel photometer mounted co-axially with a 16 mm, narrow field-of-view camera as well as 35 mm and 16 mm all-sky cameras. The 4-barrel photometer is capable of either fast-time high-level response for use against artificially induced auroras or by use of the chopper and synchronous detection to monitor the very low-level night airglow radiations. The tilting filter technique is employed on the photometer to monitor the continuum contribution to the line and band intensities to be measured. An automatic calibration system using phosphors excited by ^{14}C decay is incorporated. The photometer uses interference filters centered at 4278, 4861, 5577, and 6300 A. (auth)

23452 (AD–631225) PROPERTIES OF PHOTODETECTORS. Photodetector Series, 69th Report. Eisenman, W. L. (Naval Ordnance Lab., Corona, Calif.). Feb. 15, 1966. 57p. (NOLC–637). CFSTI $3.00 cy, $0.50 mn.

Data are presented on storage and aging effects on PbS, InSb, PbSe, and thermistor bolometer infrared detectors, and on nuclear radiation effects on infrared detectors and optical materials. These data are compilations by representatives of five detector manufacturers. (auth)

23453 (AD–631318) MANUAL OF RADIATION DOSIMETRY EXPERIMENTS. (Edgerton, Germeshausen and Grier, Inc., Boston, Mass.). July 1964. Contract DA-49-146-XZ-226. 220p. (AFRRI-CR–65-4). CFSTI $6.00 cy, $1.25 mn.

This manual contains 10 experiments covering the general field of radiobiological dosimetry techniques intended for use in a self-taught course for technical personnel who have little or no knowledge of the methods and techniques of dosimetry measurements. Emphasis is placed on routine radiation dosimetry of γ and x radiation and fast neutrons using gas ionization detectors, scintillation detectors, chemical and photographic systems, and glass and other solid-state systems. The measurement of depth doses is also stressed. (C.H.)

23454 (AD–631319) DEVELOPMENT OF A READER FOR MINIATURE CONDENSER IONIZATION CHAMBERS. Lucas, A. C. (Edgerton, Germeshausen and Grier, Inc., Boston, Mass.). Oct. 1965. Contract DA-49-146-XZ-408. 30p. (AFRRI-CR–65-7). CFSTI $2.00 cy, $0.50 mn.

Tissue-equivalent condenser ion chambers of small size were constructed for use in studies of phantoms irradiated with gamma rays and neutrons. An instrument was designed, constructed, and tested that will measure the chamber discharge with high detectability, which is important in the conduct of experiments at long distances from neutron and gamma sources. (auth)

23455 (ALO–1355-1) EVALUATION OF LARGE VOLUME DETECTORS AND THEIR APPLICATIONS TO RADIOISOTOPE PROCESS CONTROL. (Colorado School of Mines Research Foundation, Inc., Golden). May 26, 1965. Contract AT(29-2)-1355. 213p. Dep. mn. CFSTI $6.00 cy, $1.25 mn.

An investigation was conducted to determine the relative efficiencies of large volume detectors with reference to their use in process control applications. An argon-flushed, liquid scintillator using Dimethyl-POPOP in toluene in the choice of detectors, from a cost and efficiency standpoint, for use with gamma energies above one Mev. A completely inorganic environment for the scintillator, with a vacuum-aluminized reflecting surface, allows long term stability of the scintillator. Where energy discrimination is necessary, a NaI(Tl) crystal is the choice of detectors. In cases where toluene would create a fire hazard and vibration or temperature changes would affect NaI(Tl) crystals, plastic scintillators can be used. Optical coupling of the scintillator to the photomultipliers is necessary in all cases. The use of large-volume detectors on pilot size unit processes has demonstrated that the detector systems, with commercially available electronics, has the capability of controlling processes with a high degree of precision, using radioisotope concentrations as low as 2 to 10 $\mu\mu$C/ml. A mixing operation, controlled by tracer radioisotopes to maintain the two process streams in constant volume ratio, was kept in control with precision of better than 0.15 percent. The system was able to correct for a change of the volume ratio from 100 : 1 to 3 : 1. An ion exchange unit, used to depoison plating solutions, was automatically controlled in both the loading and stripping cycles. General considerations of the use of radioisotopes in automatic process control are discussed. (auth)

23456 (ANL–7108, pp 5-16) PULSED-BEAM EXPERIMENTS WITH THE VAN DE GRAAFF MACHINE. Lynch, Frank J. (Argonne National Lab., Ill.).

The time resolution that can be obtained using NaI(Tl) was investigated. The effects of improved photomultipliers and solid-state electronics were considered. (D.C.W.)

23457 (CEA-R-2839) SPECTROMETRIE β PAR DETECTEUR A JONCTION. APPLICATION A L'ETUDE DES SPECTRES DU ^{14}C ET DU ^{35}S [THESES]. (Development of a Junction β Spectrometer. Application to Study of the Spectra of ^{14}C and ^{35}S [Thesis]). Hashizume, Akira (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1966. 79p. Dep. mn.

Submitted to Paris Univ., Orsay, France.

A β-spectrometry unit using junctions of the silcon surface barrier type was built. The resolving power of this spectrometer was studied as well as the influence of a certain number of parameters (temperature, polarization voltage) on its characteristics. This spectrometer was used for a study of β-spectra in ^{35}S and ^{14}C. The calculations and corrections required for the setting-up of Kuries representation are described. The programs required for the carrying-out of these calculations with an I.B.M. computer are given. (auth)

23458 (CEA-R-2901) REALISATION ET ETUDES DES PERFORMANCES D'UN SPECTROMETRE A SCINTILLATION. (Development and Performance Studies of a Scintillation Spectrometer). Berthier, Jean; Locard, Pierre; Hocquenghem, Jean-Claude; Goin, Gerard (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Mar. 1966. 80p. Dep. mn.

A scintillation spectrometer based on the "fast-slow" coincidence technique is described. The counters use 56 A. V. P. fast photomultipliers. The fast coincidences unit can also be used as time-to-height pulses convertor. The resolving time, with two NaI crystals, is about 14 nanoseconds. It is shown that the following measurements can be made: β-γ or γ-γ coincidences, "sum-spectra," lifetime measurements, and β-γ or γ-γ directional angular correlation measurements (with detection or not of the linear polarization). The results of test measurements are given. (M.O.W.)

23459 (HMI-B-47) EIN DIFFERENTIAL-DISKRIMINATOR MIT GERINGER ZEITVERSCHIEBUNG. (Low Time Shift Differential Discriminator). Lauch, J.; Nachbar, H. U. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Mar. 1966. 17p. Dep. mn.

A differential discriminator for measuring D- and DD-clipped pulses with a duration of 0.2 to 7.5 μs and RC-clipped pulses with a decay time constant of max. 5 μs is described. Channel level and channel width are adjustable between approx. 0.1 and 10 v. The discriminator allows differential and integral operation and can be triggered at a selectable point on the leading edge or the crossover point of the input pulses. The output signal can be delayed in the range of 1 to 4 μs with negligible time shift depending on the pulse amplitude. (auth)

23460 (KFK-388) GROSSFLAECHIGER SZINTILLATIONSZAEHLER MIT ORTSUNABHAENGIGER LICHTAUSBEUTE UND SEINE BENUTZUNG ALS SCHAUERZAEHLER. (Large Area Scintillation Counter with Position Independent Light Yield and its Use as a Viewing Counter). Goerres, J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Dec. 1965. 12p. Dep. mn.

A large-area viewing counter (61 cm × 61 cm) was constructed for the separation of electrons from pions. The exciting pulses were independent of the site of origin. The construction of the counter is described, and its resolution and homogeneity of the light collection are discussed. (J.S.R.)

23461 (LNF-66/3) MISURE DI FOTOCONDUZIONE SU MONOCRISTALLI DROGATI DI CdS. (Photoconduction Measurement on Doped Monocrystals of CdS). Note No. 304. Bartolini, L. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Feb. 3, 1966. 10p. Dep. mn.

The technique used for doping semiconductor monocrystals of CdS with Cu and Ag is described. The effect of the heat treatment in sulfur and selenium vapor on the resistivity, spectral photoresponse, extinction spectrum, and on some dynamic effects under light excitation was shown. (J.S.R.)

23462 (NP-15927) RAZVITIE SPEKTROMETRICHESKOGO SPOSOBA NAKHOZHDENIYA ZAKONA RASPREDELENIYA AKTIVNOSTI PO GLUBINE AL'FA-IZLUCHATELEI. (Spectrometric Method for Determining the Law of Alpha Activity Distribution in Depth). No. 7. Chumkin, O. A.; Shorokhov, V. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Soyuznyi Nauchno-Issledovatel'skii Institut Priborostroeniya). 1965. 57p. Dep. mn.

A spectrometric method for determining the depth distribution of α-active radiation sources on the basis of pulse amplitude spectra under consideration of the angle of emission of the α particles to the surface was further developed. The method requires a mathematical treatment of the pulse amplitude spectra by means of two matrices. Results of these calculations were experimentally verified, using an industrial ionization α spectrometer with a grid-type ionization chamber and a thin ^{239}Pu emitter, covered with layers of absorbers of known thicknesses. The energy losses of the α particles passing through the absorber were taken into account. The results revealed a satisfactory agreement between the calculated and experimental values. The experiments included the depth distribution of the α activity in the upper layers of phosphorylated cellulose and in various filtering materials. The sources of error of the measurements are analyzed. (TTT)

23463 (ORNL-TM-1460) DESCRIPTION OF FACILITY RADIATION AND CONTAMINATION ALARM SYSTEMS INSTALLED IN THE LOW INTENSITY TEST REACTOR, BLDG. 3005. Russell, J. A. Jr.; Knowles, D. J. (Oak Ridge National Lab., Tenn.). Feb. 28, 1966. Contract W-7405-eng-26. 19p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Facility Radiation and Contamination Systems were installed in the Low Intensity Test Reactor, Building 3005, to continuously and automatically monitor gamma radiation (by eight gamma monitrons) and air contamination (by three beta-gamma air monitors) in the entire facility. These instruments and other components in the network provide health physics monitoring information, sound local alarms when abnormal conditions occur, and indicate these conditions on central panel boards in the control room and in the Oak Ridge Research Reactor control room. Operating personnel are first given warning when a caution level is detected by a monitron, constant air monitor, or mobile air monitor. A second warning is given when a high level is detected. The building evacuation system operates automatically when two or more of four selected monitrons or two or more air monitors detect a high level of radiation or air contamination. (auth)

23464 (STI-PUB-106) RADIOISOTOPE SAMPLE MEASUREMENT TECHNIQUES IN MEDICINE AND BIOLOGY. Proceedings Series. Proceedings of the Symposium held in Vienna, 24–28 May 1965. (International Atomic Energy Agency, Vienna (Austria)). 1965. 726p. (CONF-650507). IAEA: $15.00; Sch 315,-; £4.10.0; F Fr 60; DM 52,50.

Separate abstracts were prepared for 21 papers. For abstracts of 32 papers abstracted previously see CONF-650507 in the report number index. (C.H.)

For abstracts of individual papers see: 22564, 22565, 22843, 22933–22939, 23303–23305, and 23492–23499.

23465 (UCRL-16536) MAGNETOSTRICTIVE AND PIEZOELECTRIC READOUT OF SPARK CHAMBERS IN MAGNETIC FIELDS. Kaufman, Leon; Perez-Mendez, Victor; Pfab, James M. (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 1966. Contract W-7405-eng-48. 15p. (CONF-660304-5). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Institute of Electrical and Electronics Engineers, Scintillation and Semiconductor Counter Symposium, Washington, D. C.

Some methods by which the applicability of the magnetostrictive delay line readout for wire spark chambers can be extended for use in magnetic field regions are described. For fields up to 20 kG iron-cobalt alloy wires with either a coil or a piezoelectric receive transducer can be used. A different method involving the generation of acoustic pulses in nonferromagnetic wires is described. With a piezoelectric receive transducer this delay line is essentially unaffected by magnetic fields. (auth)

23466 (AEC-tr-6466/1, pp 111-13) PRINCIPLES OF THE DESIGN OF DIRECTIONAL RADIATION METERS. Bovin, V. P. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The principles of the design of directionally sensitive instruments for the detection and measurement of gamma radiation are outlined. (D.C.W.)

23467 (AEC-tr-6466/1, pp 135-7) DEVICES CONTAINING SOFT BETA-RADIATION SOURCES FOR MEASURING AIR POLLUTION AND SURFACE CONTAMINATION. Arkhangel'skii, A. A.; Stepanov, S. A. Translated

from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The use of a flow-type ionization chamber to monitor air pollution by soft beta emitters was investigated as well as the use of scintillation counters to determine the contamination of clothes and surfaces by soft beta emitters. (D.C.W.)

23468 (AEC-tr-6466/1, pp 138-41) MEASUREMENT OF SMALL AMOUNTS OF ^{14}C BY THE SCINTILLATION METHOD. Starik, I. E.; Shamov, V. P.; Arslanov, Kh. A.; Zharkov, A. P. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A scintillation counting assembly for extremely low levels of ^{14}C and T activity (sensitivity threshold of 10^{-11} C for T and 5×10^{-13} C for ^{14}C) is described. (G.O.Y.)

23469 ON THE BUBBLE-DENSITY VELOCITY DEPENDENCE IN A BUBBLE CHAMBER. Johansson, T. (Univ. of Lund, Sweden). Ark. Fys., 28: 461-78(1965).

The bubble-density velocity relation in bubble chambers is discussed both for moderate and extreme relativistic velocities. It is shown that the influence of secondary δ rays, i.e., δ rays not produced directly by the ionizing particle, cannot be neglected. If all electrons are considered as free, the bubble density in propane and hydrogen for velocities $\beta \lesssim 0.9$ can be expected to vary as β^{-n}, where n is about 1.89 and 1.93, respectively. If the effect of binding energies for K electrons as well as de-excitation energies in propane is included, the result will be that the absolute value of the exponent of β will fall somewhere in the region 1.76 – 1.84. The inclusion of the binding energies of tightly bound electrons leads to a relativistic increase of the bubble density. When de-excitations in heavy liquids are also included, the predicted relativistic increase is found to be quite large. It is also shown that in general the exponent of β in the bubble-density velocity relation and especially the magnitude of relativistic increase are dependent on the operation conditions of the bubble chamber. (auth)

23470 MEASUREMENT OF VERY HIGH DOSE RATE OF IONIZATION RADIATION BY IONOMETRIC METHOD. Sewkor, A. (Max Planck-Institut fuer Biophysik, Frankfurt am Main). Biophysik, 3: 8-10(1966).

A miniature ionization chamber of air-equivalent material in the form of a thimble is described. By means of this ionization chamber in connection with a Siemens universal dosimeter system it is possible to measure dose rates up to 1.55 million R per minute. (auth)

23471 SHORT-TIME MEASUREMENTS. Mirat, G. Bull. Inform. Sci. Tech. (Paris), No. 99, 21-32(Dec. 1965). (In French).

Nanosecond time measurements are currently needed in nuclear physics experiments. Different methods for single, recurrent or erratic phenomenon are examined. A time-to-amplitude converter operating to 10^5 counts/s. in statistic mode is described. (auth)

23472 SPECTROMETRIC GAMMA-QUANTUM COUNTER BASED ON GERMANIUM WITH RADIATION DEFECTS. Ryvkin, S. M.; Matveev, O. A.; Strokan, N. B.; Khusainov, A. Kh. Dokl. Akad. Nauk SSSR, 165: 548-50(Nov. 21, 1965). (In Russian).

The design and operating characteristics of semiconductor γ-counters based on germanium with radiation defects produced by γ rays of ^{60}Co are discussed. The counters were found to possess features superior to those of lithium-doped detectors with respect to amplitude resolution. For example, for γ-quanta with energies below 350 kev an absolute resolution of 4.0 ± 0.8 kev was obtained; for 662-kev and 1.33-Mev lines, resolutions of 4.5 and 1.0 kev were obtained. The absorption of γ-quanta of ^{60}Co, which were used to produce defects in germanium, was one of the obstacles encountered in designing counters with a larger field. However, counters with a wide active region (d_0 = 3 mm, where d_0 is the distance between the n′ and p′ layers) were obtained by γ irradiation. A drop in the capacitance of detectors caused by an increase in d_0 made it possible to reduce the noise level and to obtain a resolution of 2.7 ± 0.15 kev for γ-quanta of ^{57}Co (122 kev). For the 1.33-Mev line, the resolution was 5.6 ± 0.5 kev. (CFSTI)

23473 NOISE FIGURE AND FIGURE OF MERIT FOR NUCLEAR RADIATION DETECTORS. Scott, L. (Swiss Federal Inst. of Tech., Zurich). Electron. Lett., 2: 110-11(Mar. 1966).

The measurement of the energy of a nuclear particle by ionization methods is limited in accuracy by the statistical fluctuations occurring in the detection process, including those in the associated electronic circuits as well as those occurring at the source of the particles. The noise figure defined in this note indicates the relative size of these two sources of fluctuations which limit the energy resolution. The generalized noise-figure definition is as given by Friis. The necessary statistical theorem is derived, which yields the fluctuations in the detection process, assuming a multiplicative process of detection; i.e., each primary particle produces a large number of secondary charge carriers. After adding the effects of the associated electronic circuits, the resulting noise figure F_R contains as a figure of merit for nuclear-radiation detectors the excess noise figure $F_R - 1$. (auth)

23474 SOLAR WIND DEUTERIUM DETECTOR AND CHARGE SPECTRUM ANALYZER. Floyd, Frank W. (Lincoln Lab., Lexington, Mass.); Scherb, Frank. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 18-24(Apr. 1966).

A discussion of a future satellite-borne experiment which will investigate the abundance of deuterium and possibly of ^3He in the solar wind is presented. The nuclear reaction $d + t \rightarrow {}^4He + n + 17.6$ Mev is reviewed. The deuterium detector is described, and an experimental evaluation of the instrument is presented. The effects of ^3He in the solar wind on the deuterium detector are considered. (B.G.D.)

23475 A COINCIDENCE DETECTOR EASY TO BUILD. Roucayrol, J. C.; Perrin, J. (Faculte de Medecine, Paris). Int. J. Appl. Radiat. Isotop., 17: 134(Feb. 1966). (In French).

A coincidence detector designed for the measurement of β activities directly on filter paper or thin foils cut into discs and impregnated with liquid scintillator is described and shown graphically. The detection efficiency for ^{14}C is 60% on disc of electrophoretic membrane impregnated with a toluene-base liquid scintillator. (J.S.R.)

23476 INVESTIGATION ON THE RESOLUTION AND THE PULSE HEIGHT COEFFICIENTS OF TEMPERATURE OF NaI(Tl) CRYSTALS, BETWEEN +25 DEG C AND −130 DEG C. Yenicay, Guelay (Univ. of Istanbul). Istanbul Univ., Fen Fak. Mecmuasi, Seri C, 30: 17-32(Jan.-Apr. 1965).

The variations of the energy resolution and of the pulse height of two NaI(Tl) crystals, were investigated between +25°C and −130°C. It was found that: (1) the resolution increases linearly as the temperature decreases: for example, the percent resolution of the 1.75 × 2 in. crystal increases from 13 to 27. The resolution temperature coefficient is −0.099 ± 0.04% (°C) for the 1 × 1 in. crystal, and −0.11 ± 0.03% (°C) for the 1.75 × 2 in. crystal. (2) between +25°C and −65°C the pulse heights decrease linearly with the temperature, whereas they remain approximately constant from −65°C down to −130°C. The temperature coefficient between +25°C and −65°C is +0.117 ± 0.05 (°C) for the small crystal and +0.132 ± 0.02 (°C) for the large one. (auth)

23477 MICROSCOPE FOR MEASURING GEOMETRIC PARAMETERS OF PARTICLE TRACKS IN NUCLEAR EMULSIONS. Raguzin, R. M. Izmeritel. Tekh., No. 1, 39-41(Jan. 1966). (In Russian).

The geometric characteristics of charged-particle tracks in nuclear emulsions, such as their length and the angle formed with each other, allowing calculation of their energy, mass, etc., were until recently determined by manual methods. This caused difficulties for projects requiring the evaluation of thousands of plates. Therefore, a semi-

automatic microscope, designated as MIGE-1, was developed and connected to a specially designed computer; the system was in actual operation since 1962. The efficiency of the human operator was increased by a factor of 20 to 25, making it possible to determine the parameters of about 500 tracks during the normal workday. The optical system allows visual observation at magnifications of 70× to 1800×; the table may be adjusted with an accuracy of ±0.005 mm. The X, Y, and Z coordinates are recorded on a magnetic tape, together with information concerning the number of the event, number of the plate, shrinkage coefficient of the emulsion and magnification; about 6000 points may be recorded on a 500-m long tape, moving at a rate of 19.05 cm/sec. The binary computer operates at a rate of 300 operations per second, while the results are printed in the decimal system at a rate of 5 lines per second. The optical and mechanical features of the system are shown schematically. Ferrite transistor units are used for the logical system. (TTT)

23478 PLAN FOR A LARGE INSTALLATION AT YAKUTSK FOR STUDY OF EXTENSIVE AIR SHOWERS. Vernov, S. N.; Egorov, T. A.; Efimov, N. N.; Krasil'nikov, D. D.; Kuz'min, A. I.; Maksimov, S. V.; Nesterova, N. M.; Nikol'skii, S. I.; Sleptsov, E. I.; Shafer, Yu. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1690-2(Sept. 1965). (In Russian).

An installation to be completed in the next two or three years near sea level at latitude 62° N in the Yakutsk region is described. The installation will yield information concerning the energy spectrum, composition, and anisotropy of primary cosmic rays with energies up to 10^{20} ev. The installation, intended for investigation of extensive air showers, will comprise 65 stations spread over an area of 23 km^2. Each station will be equipped with scintillation counters with a total sensitive area of 1 m^2 or 4 m^2, and at the central station, 10 m^2. The total sensitive area of scintillation counters in the whole installation will be 204 m^2. Each station will be equipped with photomultipliers for recording the Cherenkov flash accompanying a shower. In addition, there will be muon detectors with a total sensitive area of 22 m^2. Pulses will be transmitted from the more remote stations to the central laboratory by radio. It is anticipated that, this installation will record 2×10^5 showers per year with energies exceeding 10^{15} ev and 2 showers per year with energies exceeding 10^{20} ev. (ATD)

23479 RADIOSONDE FOR MEASUREMENT OF X-RAY PHOTONS IN THE STRATOSPHERE. Bazilevskaya, G. A.; Kvashnin, A. N.; Krasotkin, A. F.; Filatov, V. M.; Charakhch'yan, A. N. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1774-6(Sept. 1965). (In Russian).

Two radiosondes for measuring x rays in the stratosphere are briefly described. Both instruments employ NaI:Tl scintillators and vacuum-tube electronics and are battery powered with transistor voltage convertors. The lighter instrument weighs 2.5 kg and records photons with energies above 30 to 35 kev. The second instrument weighs 6 kg, and its threshold is adjustable from 20 to 360 kev by a system of relays, so that photon energy spectra can be recorded. Schematic diagrams are given for both instruments. Recorded altitude versus counting rate curves are presented. (ATD)

23480 SOME CHARACTERISTICS OF WIDE-GAP SPARK CHAMBERS AND APPLICATIONS OF SUCH CHAMBERS IN COSMIC-RAY PHYSICS. Bolotov, V. N.; Devishev, M. I.; Klimanova, L. F.; Luchkov, B. I.; Shmeleva, A. P. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1777-80 (Sept. 1965). (In Russian).

A review is presented on the characteristics of wide-gap spark chambers and their use in cosmic-ray physics. The effects of gap size, electric field uniformity, particle direction with respect to the field, gas purity, and delay between particle passage and application of the field on the angular dispersion of the particle tracks and on the efficiency of shower detection are considered. The streamer chamber, which permits recording of narrow tracks of particles moving in an arbitrary direction with respect to the electric field, seems to be the best track chamber for accurate determinations of track directions and curvatures. (M.J.T.)

23481 HIGH-PRECISION COUNTER TELESCOPE FOR RECORDING THE TOTAL COSMIC RAY FLUX WITH ENHANCED STATISTICS. Blokh, Ya. L.; Dorman, L. I.; Inozemtseva, O. I.; Leonov, V. Kh.; Mazaryuk, E. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1781-3(Sept. 1965). (In Russian).

The design of a crossed counter telescope for recording the total cosmic-ray flux is discussed. Design calculations for 25 different geometries were performed by a generalization of a method previously developed for calculating directional curves for cubic geometry. The instrument was designed without lead to simplify the construction and to permit recording of the electron component, which is most sensitive to anisotropy effects. The final design consists of 16 identical elements containing 10 counters each and arranged in a rectangular parallelepiped with the square faces horizontal. Counts are recorded in five principal directions and in four supplementary diagonal directions. The half-width of the directional diagram is 24°, the effective zenith angle is 33°, and the acceptance is 0.3 sterad. The sensitive area is approximately 4 m^2 in each direction, and a statistical accuracy of 0.14% is anticipated for a 2 hour run. Correction will be made for changes in the accidental coincidence rate due to changes in the cosmic-ray flux. (ATD)

23482 DESIGN PROBLEMS OF LARGE SCINTILLATION COUNTERS WITH A SINGLE PHOTOMULTIPLIER. Egorov, T. A.; Efimov, N. N.; Krasil'nikov, D. D.; Koryakin, V. D.; Maksimov, S. V.; Sleptsov, I. E. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1788-90(Sept. 1965). (In Russian).

Scintillator-photomultiplier arrangement and reflector shape are optimized to decrease the influence of particle-trajectory location upon photomultiplier output and to improve reliability of registration of low-density cosmic particles. In the experimental arrangement, a plastic scintillator occupied only one quadrant of the reflecting container base. A single FEU-44 photomultiplier was used with its axis along the axis of the container. A diffusely reflecting Whatman paper was used as the reflecting surface covering. The location of particle trajectories was determined by a telescope system. The area of the scintillator was divided into 16 equal areas, and selections were made of vertical trajectory particle passages within a solid angle of .014 sterad. The optimum arrangement gave only about 20% attenuation for signals arriving from scintillator edges, permitting registration of a single cosmic particle with high reliability. (ATD)

23483 A METHOD OF DISPLAYING COSMIC-RAY DETECTOR RECORDS. Barouch, E. (Laboratoire de Physique Cosmique, Verrieres-le-Buisson, France). J. Phys. (Paris), 26: 241A-3A(Dec. 1965). (In French).

A method for smoothing cosmic ray detector records is given, which permits the phase and amplitude of periodic variations to be more easily and accurately found. This is done by taking the convolution product of the recorded sequence with a function whose Fourier transform is zero outside a closed interval. The special case in which the Fourier transform is also zero in the neighborhood of the origin is illustrated by an example. (auth)

23484 DISCRIMINATION OF π^+ AND PROTONS BY THEIR BUBBLE DENSITIES. Tridon, J. (Univ. Paris, Orsay, France). J. Phys. (Paris), 26: 785-8(Dec. 1965). (In French).

In a bubble chamber, it is difficult to distinguish π^+ from protons of large-momentum impulses by a visual estimation of their bubble densities. It was determined in this study which indications can give, beyond this threshold, a measurement of those densities. (auth)

23485 COMBINED SLOT-COLLIMATOR FOR MEASURING THE DISTRIBUTION OF γ-RADIATING ISOTOPES. Inzeltne, Gerber Edit; Molnar, Sandor (Eoetvoes Lorand Tudomanyegyetem Fizikai-Kemiai es Radiologiai Tanszeke, Budapest). Magyar Kem. Foly., 71: 511-21(Dec. 1965). (In Hungarian).

A combined slot-collimator is described for measuring linear γ activity distributions, e.g., in a capillary tube. Its efficiency, with reference to a ^{131}I point source, is 48%, with a stripe width of B_{50} = 1.5 mm, so that measurements of considerable accuracy can be carried out. The high efficiency decreases the expenses of safety precautions by decreasing the activities necessary for measurements. (auth)

23486 BETA COUNTER WITH A SMALL BACKGROUND. Biro, Janos; Feher, Istvan; Szabo, Laszlo; Szamosi, Gyoergy (Magyar Tudomanyos Akademiai Koezponti Fizikai Kutato Intezete, Budapest). Magyar Kem. Foly., 71: 533-5(Dec. 1965). (In Hungarian).

An installation designed for the determination of the activity of the order of a picocurie is described. In the device two G-M counters were used which were included for the anticoincidence circuit. Suitable shielding and electric schemes were obtained which insure that the background of the device does not exceed 0.9 ± 0.1 pulses/min at sensitivities characteristic for other devices working with G-M counters. (tr-auth)

23487 NEUTRON DOSIMETRY IN RADIOLOGICAL PROTECTION AT THE ATOMIC RESEARCH ESTABLISHMENT, HARWELL. Dennis, J. A. (Atomic Energy Research Establishment, Harwell, Eng.). Nippon Genshiryoku Gakkaishi, 8: 36-40(1966). (In Japanese).

The activities at Harwell in neutron dosimetry can be considered to have passed through three distinct periods. From 1949 to 1951 various attempts were made to derive maximum permissible levels; from 1954 to 1958 instruments based on the 1955 ICRP recommendation were developed; and since 1959 the physical bases of the calculations are being experimentally verified and gaps in instrumentation filled. The work on neutron dosimetry at Harwell is described under the four headings of derivation of maximum permissible levels of neutron fluxes, the personnel dosimeter, the dose-rate meter, and measurement of neutron fluxes and absorbed doses. (auth)

23488 DETERMINATION OF THE ACTIVITY OF RADIOACTIVE NUCLIDES IN THE GAS PHASE. I. INVESTIGATIONS OF SOURCES OF ERROR IN THE MEASUREMENT OF GASEOUS RADIOACTIVE NUCLIDES PRESENT IN PROPORTIONAL COUNTERS. Modes, D.; Grosse, H.-J.; Koch, H.; Roesseler, M. (Institut fuer Angewandte Radioaktivitaet, Leipzig). Nukleonik, 8: 15-21(Jan. 1966). (In German).

By means of a special wall-less counter tube, an analytical function was derived which characterizes the gas discharge mechanism in the limited proportional range and assigns each pulse magnitude of a given particle energy. On the basis of this assumption the corrections in the absolute determination of the activity of gaseous radionuclides present in cylindrical counters were methodically investigated. (tr-auth)

23489 SEQUENTIAL DELAY SAMPLING TIME ANALYZER. Sasaki, Hirotaka (Matsushita Electric Industrial Co., Ltd., Japan). Oyo Butsuri, 35: 34-40 (Jan. 1966). (In Japanese).

For improvement of accuracy of measurement by the pulsed neutron method in nuclear reactor physics, a sequentially delayed sampling time analyzer was developed. The analyzer has 256 channels with a minimum channel width of 0.1 μsec; it measures the time variation of the thermal neutron flux by sampling the flux every 15 μsec. The sampling times are made to delay by a 1.6-μsec increment every burst of fast neutrons, whereby an effective sampling rate of 1.6 μsec and measurement of rapid variations of the flux are attained. This device is used as a plug-in unit in connection with a pulse analyzer of 1024-channel, 16-bits/ch magnetic memory cores. In a diffusion test with graphite moderator in a semihomogeneous critical assembly of the Japan Atomic Energy Research Institute, the time resolution of the analyzer was confirmed to be about 10 times that of conventional analyzers. (auth)

23490 IMPROVED SURFACE-ANGLE METHOD FOR SCATTERING MEASUREMENTS ON DIPPING TRACKS IN NUCLEAR EMULSIONS. Friedlaender, E. M.; Visky, T. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 871-4(1965).

In order to broaden the energy range accessible to measurements of multiple Coulomb scattering on dipping tracks it appears of interest to improve the accuracy of the so-called surface-angle method suggested by Barkas et al. This accuracy is necessarily limited by the width of the coordinate grating and by misalignment of the stack. A substantial increase of the accuracy of the method can be achieved if the surface angles are measured with respect to the average direction of a well-collimated beam of high-energy particles shot glancing into the stack. The experiment described below has shown that under such conditions one may achieve an angular inaccuracy below 4.5×10^{-2} degrees, i.e., a noise of at most 6.5×10^{-2} degrees in the scattering angles. In the dip range investigated here this corresponds to an upper limit for the measurable $p\beta$ of 2 Bev/c. (auth)

23491 THE SECONDARY EXTINCTION AND OPTICAL PROPERTIES OF NEUTRON CRYSTAL SPECTROMETERS. Popovici, M.; Gelberg, Doina (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 1035-50(1965). (In French).

The effect of secondary extinction on the resolution and luminosity of a crystal spectrometer and the dependence of the luminosity with respect to the mosaic divergence of the monochromator in the general case of asymmetric collimation of incident and reflected pulses is studied. The results obtained are used to calculate the luminosity of a diffraction apparatus on powders and for the study of the optical properties of a spectrometer with three axes for elastic and isotropic scattering. (J.F.P.)

23492 AUTOMATIC SAMPLE CHANGING SYSTEM FOR GAMMA-RAY SPECTROMETRY. Lamson, K. C.; Sesko, W. J.; Nicholson, G. C. (Northeastern Radiological Health Lab., Winchester, Mass.). pp 127-36 of STI-PUB-106.

The detection of γ-emitting radionuclides at environmental levels in biological media requires that the sensitivity of the counting system be high. To accumulate sufficiently precise data, it is often necessary to count samples for periods of time of from one to several hours. The most efficient utilization of expensive low-background γ-ray spectrometric counting equipment requires that it be operated on a continuous basis. This necessitates either the continuous presence of personnel or a completely automated system, including the changing of samples and recording of data. The automated γ-ray spectrometry counting system designed, built, and in use at the Northeastern Radiological Health Laboratory, Winchester, Massachusetts, is described. The sample changing unit was designed to operate in conjunction with a large steel shield, any commercial unit with a front opening door being readily adaptable for this purpose. The changer is equipped to handle a variety of samples including biological and medical types. The unit consists of a revolving tray with a capacity for sixteen samples, an indexing system for positioning the samples, a mechanical arm with an attached electromagnet for inserting and removing the samples from the shield, and a lever for opening and closing the shield door. The changer has been completely integrated with a multichannel analyzer with the provision of safety features to interrupt the cycle in case of malfunction at any step. After a preset counting period, the data are punched onto paper tape and processed by an IBM 1620 computer. The first model of the sample changer, for which a patent is pending, has been in operation at the Northeastern Radiological Health Laboratory for about one year. During that time, it has been used extensively and has proven completely satisfactory. The total cost of the unit, including labor, was less than $2000. (auth)

23493 IMPROVEMENT OF LIQUID SCINTILLATION COUNTING EFFICIENCIES BY OPTIMIZATION OF SCINTILLATOR COMPOSITION. RELATIVE EFFICIENCIES FOR THREE NEW FLUORS. Bush, E. T.; Hansen, D. L. (Nuclear-Chicago Corp., Des Plaines, Ill.). pp 395-408 of STI-PUB-106.

In the course of an evaluation of three new phosphors for liquid scintillation counting, it became apparent that the usual formulations of liquid scintillator solutions are far from optimal for most counters and for most quenched samples. Primary solute concentrations several times as large as are usually used may be required for achievement of highest counting efficiency. The secondary solute, at the concentrations conventionally used to provide wavelength-shifting, may contribute little or nothing to counting efficiency in many modern commercial counters. At much higher concentrations, however, the secondary solute may provide a striking increase in efficiency for quenched samples in counters in which it does not improve unquenched samples. This implies a different function for the secondary solute which has not been previously described. Excitation of such solutions by ultraviolet light provides insight into this behavior. Two new secondary solutes were studied, bis(isopropylstyryl)benzene or BPSB, and p-bis[2-(4-methyl-5-phenyloxazolyl)] benzene or dimethyl POPOP. The latter has been commercially available for some time, but reports as to its effectiveness have varied. The former is expected to be marketed soon, and no data on it have been published previously. These were compared with p-bis[2-(5-phenyloxazolyl)] benzene or POPOP as a standard. A new primary, 2.5-bis-[5′-tert.butylbenzoxazolyl(2′)]-thiophen, or BBOT, having an extraordinarily long wavelength, was compared with PPO, 2,5-diphenyloxazole, and PBD, phenylbiphenyloxadiazole-1,3,4. The way in which counting efficiency varies with fluorescent wavelength is a function of counter optics, and, to a lesser extent, of the individual (S-11 type) multiplier phototube. Three types of commercial counter were compared, in which the reflecting surfaces of the sample chamber were of (1) TiO_2 paint, (2) formed Al, or (3) evaporated Al on a plastic light guide surrounding, but not optically coupled to, the sample bottle. The range of response in phototubes was studied by using numerous counters of a given type. Tritium and ^{14}C were counted in samples prepared with solvents and quenching substances typical of those used in biological tracer studies. (auth)

23494 STANDARDIZATION OF A LIQUID SCINTILLATION SYSTEM. Smith, A. H.; Reed, G. W. (Univ. of Leeds, Eng.). pp 427-45 of STI-PUB-106.

An experimental evaluation was made of methods in current use for the routine standardization of liquid scintillation systems, with special reference to a single photomultiplier arrangement applied to the measurement of tritium in liquid samples. The investigation includes consideration of the problem of scintillator phosphorescence as well as those disadvantages usually associated with the internal standardization procedure, such as the necessity for very accurate dispensing of the small volumes involved. The complications due to phosphorescence, which also accompany the ^{57}Co internal standard method, may be circumvented in the various ways discussed, but special attention has been given to the more satisfactory standardization procedure, the channel-ratio method. This method, which has the advantage of simultaneous measurement both of sample and quenching factor, has been studied in detail using a dioxane-based scintillator and an aqueous tritium standard. Pulse-height spectra were obtained for both quenched and unquenched samples (utilizing both chemical and color quenching) and the variation of count-rate with pulse height was found to be exponential. The constant of the exponential was characteristic of the degree of quenching and bore a linear relationship to the relative efficiency over a wide range. Since color quenching is usually accompanied with some chemical quenching, an attempt was made to separate the two effects. They were found to produce similar results down to an efficiency of 15% relative to the unquenched sample. Analysis of the experimental data suggests methods for selecting optimum settings for the two channels over this quenching range according to the requirements of the specific problem. An experimental relationship was also obtained for ^{57}Co internal standardization. Finally the channel ratio, ^{57}Co and internal standard methods were intercompared for various quenching agents. Although the results obtained were not widely different, the practical conclusion reached was that, for high count-rates, the channel ratio technique would be the method of choice, whereas at low count-rates the internal standard or ^{57}Co methods have the advantage. Some consideration is given to the possible superiority of a suitable beta-ray emitter used as a standardizing source. (auth)

23495 ^{14}C AND ^{3}H MEASUREMENT BY MEANS OF A LIQUID SCINTILLATION SPECTROMETER: COLOUR QUENCHING. Iwakura, T.; Kasida, Y. (National Inst. of Radiological Sciences, Chiba, Japan). pp 447-55 of STI-PUB-106.

An attempt was made to correlate color quenching and wavelength of the absorption maximum in liquid scintillators. Attempts were also made to find a difference in discriminator ratio versus counting efficiency curves between chemical and color quenching. Fourteen photosensitive cyanine dyes were used as coloring agents in alcohol solution. The concentration of the dye in the counting samples ranged from 0.5 to 10×10^{-6} M to give the desired absorbance in the liquid scintillator medium. Toulene-1-^{14}C and toulene-^{3}H were used as the internal standards. Counting was carried out with a Packard TRI-CARB Model 314 EX2 liquid scintillation spectrometer. Discriminator settings were 100 to 1000 divisions for the red channel and 186 to 1000 divisions for the green channel. The high voltage applied to the photomultiplier was selected to give balance point operation in the red channel in an unquenched sample. Concentration of dyes against extent of quenching was examined. Because of the characteristic wavelengths of light emitted by the scintillator systems and the response of the photomultipliers (S-11 response), it was expected that red and yellow solutions which have maximum absorption at 400–500 nm would show the greatest quenching effect. To evaluate the total color quenching, the following relationship was used to define the total absorption coefficient: $\bar{A} = \Sigma A_i W_i / \Sigma W_i$, where W_i is the relative photomultiplier sensitivity for light within the spectral range i nm, and A_i is the absorbance of light within the spectral range i nm used. Total absorbance was calculated for each 40 nm range, 360–400, 400–440, etc., to 520–560 nm. The reciprocal absorbance 1/A versus the counting efficiency shows a linear relationship over a wide range of counting efficiencies. The curves of the discriminator ratio versus counting efficiency show that when color quenching becomes strong, the color quenching curve separates from the chemical quenching curve in ^{14}C counting. On the other hand, similar measurements made in counting ^{3}H do not show a separation of the two quenching curves. (auth)

23496 INFLUENCE OF BREMSSTRAHLUNG IN ACTIVITY MEASUREMENTS BY WELL-TYPE GAMMA-IONIZATION CHAMBERS OF 4π GEOMETRY. Dalmazzone, J.; Guiho, J. P.; Grinberg, B.; Le Gallic, Y. (Centre d'Etudes Nucleaires, Saclay, France). pp 599-611 of STI-PUB-106. (In French).

Radioactive solutions are generally measured in hospitals by means of well-type gamma-ionization chambers of 4π geometry; this is done either by taking control measurements on receipt of the solution or by measuring the solution after dilution and before it is administered to the patients. These chambers are sensitive to the bremsstrahlung produced by the beta-rays emitted by the radionuclides, and, as a consequence, the results obtained are distorted unless an appreciable error is taken into account. The effect of the volume of the source on the contribution of bremsstrahlung to the global effect was measured. The experimental curves obtained for beta- and beta-gamma-emitters and electron capture nuclides are discussed. The radioisotopes used in medicine and biology, such as ^{32}P, ^{42}K, ^{90}Y, ^{131}I, ^{198}Au, produce considerable bremsstrahlung. The correction factors, which vary from 1.4% for ^{198}Au to 15% for ^{42}K when the volume varies from 1 to 5 cm^3 in the sealed tube, are analyzed. The specific calibration coefficients were determined taking into account corrections determined previously as a function of the radionuclide under consideration and of the source-chamber geometry. (auth)

23497 PRECISE MEASUREMENT OF THE ACTIVITY OF LOW-ENERGY BETA-EMITTERS WITH CALIBRATED IONIZATION CHAMBERS. Goodier, I. W.; Hughes, F. H.; Williams, A. (National Physical Lab., Teddington, Eng.). pp 613-23 of STI-PUB-106.

The use of calibrated ionization chambers for accurate measurements of the activity of gamma-emitting nuclides is well established and widely used. At the moment it is not possible to obtain the same accuracy for nuclides which decay only by beta-emission and the accuracy obtainable is less the lower the end-point energy of the beta decay. For beta-emitters with end-point energies in excess of 1 Mev, the usual method of source preparation, which involves evaporating to dryness a known weight of the active solution, produces sources in which the self-absorption is sufficiently constant to obtain accuracies of the order of 0.5%. But this method of source preparation is not suitable when the end-point energy is much less than 1 Mev. In the case of ^{35}S, for example, with an end-point energy of about 150 kev this method of source preparation would give an accuracy of not much better than 5%. Several methods of improving the accuracy of the measurements with low-energy beta-emitters are described. Calibrating the ionization chamber is also a difficult problem for these nuclides because of the self-absorption in the sources used for determining the absolute value of the activity. The efficiency tracer technique is widely used to overcome this difficulty and some of the recent developments of this method will be given and the accuracy obtainable by this method will be discussed. (auth)

23498 PRECISE PROPORTIONAL COUNTING OF BETA-RAY EMITTING LIQUID. Miguel, M.; Houtermans, H. (International Atomic Energy Agency, Vienna). pp 625-32 of STI-PUB-106. (In French).

Samples of beta-ray emitting liquids are often assayed using an all-glass G-M counter where the liquid is placed between an outer cylinder and the counting tube (Veall-type counter). Besides the well-known disadvantages of G-M tubes, these jacketed counters are difficult to handle, fragile, and apt to change their counting characteristics. A methane-flow proportional counter was developed specifically for β-emitting liquid samples. The liquid is placed in a plastic cylinder with a bottom of aluminized mylar foil (1 mg/cm^2). This vessel is screwed into the top of a circular proportional counter. In case of contamination, the vessel can be replaced. When the bottom foil is exchanged, a calibration curve, giving the efficiency as a function of the measured weight per unit area, may be used to obtain a new value for the efficiency. This counter was used successfully for the assay of ^{32}P, ^{204}Tl, and ^{35}S solutions giving results reproducible to ±0.2%. Compared with the jacketed counter, the counting efficiency of our counter is higher for low-energy β-emitters. (auth)

23499 SOME APPLICATIONS OF SURFACE BARRIER SOLID-STATE DETECTORS FOR ALPHA-ACTIVITY DETECTION AND MEASUREMENT. Perry, K. E. G. (Atomic Energy Establishment, Winfrith, Eng.). pp 685-98 of STI-PUB-106.

The solid-state detector shows an advantage over other forms of detector (e.g., scintillation counter or gas-flow proportional counter) in that a much lower background is possible and thus a lower level of activity can be determined. Two types of apparatus using solid-state detectors are in common use. The simplest form of equipment incorporates a solid-state detector to measure the total alpha-activity of the sample. However, if other alpha-active isotopes are present, then to obtain a true estimation of the plutonium content, the solid-state detector can more usefully be employed as a spectrometer; by pulse amplitude analysis it is possible to differentiate the 5.14-Mev emission of plutonium from the alpha-emissions of other nuclides. For very high resolution energy analysis (>1%) the sample is measured in vacuum with a selected solid-state detector and the output taken to a multichannel analyzer. Details of this equipment and the results obtained are presented. A new design of automatic alpha-assay equipment, including a solid-state detector, was employed for monitoring the filter papers taken from personnel air samplers that have been worn by personnel employed in handling plutonium. This equipment automatically counts each of 12 filter papers for a pre-determined period and prints out the total counts recorded. Considerable use has also been made of solid-state detectors in various types of probes for general alpha monitoring. An important further attractive feature of the solid-state detector is lack of response (compared to the normal ZnS scintillation counter) to gamma-radiation. (auth)

23500 A FAST CHOPPER WITH ADJUSTABLE SLIT FOR STUDYING RESONANCE NEUTRONS. PART II. CONSTRUCTION. Dobrescu, S.; Olteanu, I. (Inst. of Atomic Physics, Bucharest). Studii Cercet. Fiz., 18: 3-11(1966). (In Rumanian).

Fast choppers are usually larger and more complex than the thermal devices because the neutron pulse must be very short (about 1 μsec) and thickness of the materials must be increased in order to stop the epithermal neutrons. Constructional problems involved in the design and installation of the fast chopper in the horizontal beamhole of the VVR-S reactor are reviewed. It operates at a tangential velocity of 210 m/sec, subjecting the shutter rotor to high stresses. A vertical suspension method was chosen because it presents fewer constructional problems. The rotor was built from two 402-mm OD steel flanges, with a 380-mm OD Plexiglas ring. In order to compensate for the lower scattering cross section of Plexiglas at increased neutron energies, and for the low γ-attenuation coefficient, a steel centerpiece was installed in it. The optical system included a light source, two Al mirrors and a photomultiplier. A cryostat allows experiments to be carried out at liquid nitrogen temperatures. The flight tube was 25 mm long. Thick wood boards provided protection against mechanical failure, while the biological shield included water-filled containers. The neutron detection system was based on BF_3-filled proportional counters and scintillators. The system was operated successfully for three years. (TTT)

23501 ON ION DETECTION WITH PHOTO PLATES. Franzen, J.; Maurer, K.-H.; Schuy, K. D. (Max-Planck-Institut fuer Chemie, Mainz). Z. Naturforsch., 21a: 37-62(Jan.-Feb. 1966).

The equation for the transparency curve, produced by ions of 10–100 kev, is derived from basic principles by suitably modifying Kinoshita's assumptions. Agreement with experimental curves is demonstrated. The shape of the transparency curve (T vs log of ion density) was investigated for several developers at various developing temperatures and developing times, for the improved Ilford Q2 emulsion. Plates were exposed with 28 kev Kr^+-ions. A statistical effect, observed for all developers, is superimposed by two developer-dependent effects. The consideration of background fog necessitates the differentiation of two types of background: a fog due to light quanta or plate storage, and a surface fog due to particles with limited penetration depth into the emulsion. Equations are derived correcting measured transparencies for both types of background. Background fog reduces the photographic sensitivity. A theoretical equation gives the loss of photographic sensitivity for ion-produced fog. A similar equation is valid for light- and plate storage-produced fog; it then contains a parameter, which has to be determined experimentally. Agreement with experiment is demonstrated. Grain size and grain density of Ilford Q2 emulsions are determined from photometric measurements of statistical fluctuations of the blackening for various developing conditions. For most developers, the grain density increases with increasing developing time, the grain size remaining constant. The maximum attainable precision of photometer transparency and ion current density measurements for a given line area is stated. (auth)

23502 ANGULAR DISTRIBUTION OF LIGHT FROM A NaI(Tl) SCINTILLATOR. Daich, A. R.; Tsirlin, Yu. A. Zh. Prikl. Spektrosk., 2: No. 1, 80-2(1965). (In Russian).

The angular dependence of the intensity of light from a packed NaI(Tl) crystal was investigated experimentally with an installation in which the scintillator was excited with

collimated gamma radiation from ^{60}Co and the luminescence light was made to strike a photographic film. A diagram of the installation is shown. The film was developed under controlled conditions and the crystal emission curves were determined by microphotometry of the film. The results are shown and indicate that anisotropy of the light intensity is observed whether or not an optical constant is present. It is pointed out in conclusion that the results can be used to obtain more precise data on the light transmission from the NaI(Tl) detector over a light pipe. (ATD)

23503 DETERMINING THE EFFECTIVE COEFFICIENT OF LIGHT ABSORPTION IN LONG PLASTIC SCINTILLATORS. Tsirlin, Yu. A.; Daich, A. R.; Sokolovskaya, T. I.; Nagornaya, L. L. Zh. Prikl. Spektrosk., 2: No. 4, 371-3 (1965). (In Russian).

It is shown that the attenuation in the scintillator material of light emitted by that scintillator may be determined only by measuring the luminescence spectrum, spectral sensitivity of the photocathode which detects the radiation, and spectral coefficient of absorption of the scintillator material throughout the entire range of wavelengths emitted by the scintillator. An experimental method is described for direct determination of the "effective" coefficient of absorption. The transmittance of α-stimulated light is measured in long cylinders of scintillation plastic. In a second set of experiments, the transmittance of light stimulated by a collimated beam of γ rays is measured. The results are given in graphic form. A formula is derived for the transmission factor as a function of length. (ATD)

23504 LUMINESCENCE YIELD OF PLASTIC SCINTILLATORS AS A FUNCTION OF EXTERNAL ELECTRON ENERGY. Tsirlin, Yu. A.; Sokolovskaya, T. I.; Nikulina, R. A.; Nagornaya, L. L. Zh. Prikl. Spektrosk., 3: No. 2, 156-61(1965). (In Russian).

The luminescence yield of various plastic scintillators was studied as a function of electron beam energy. The measurements were made on an apparatus shown. An electron beam from the source is accelerated in a tube to an energy of 70 kev and falls on the plastic scintillator which is mounted on an FEU-13 photomultiplier placed in a vacuum chamber. The beam is irised down twice on its path to a final spot size of 3 mm on the specimen. More light was collected by using aluminum reflector. The plastic scintillators studied were divided into the following four groups: with different bases and identical primary and secondary additives in optimum concentrations for the given base; with the same base but with various primary additives in optimum concentrations; with the same base and the same primary additive in various concentrations; with identical bases and identical primary additives, but different secondary additives. Plastic scintillators from these groups were made in the form of polished cylinders 18 mm in diameter and 2 mm high. The results are tabulated and also given graphically. The luminescence yield of these plastic scintillators is not proportional to the external electron energy, and the specific light output L/E is a variable in the low energy range from 0 to 70 kev. It was found that polyvinyl xylene and polystyrene bases are nearly identical in their degree of proportionality, which is higher than that of a polyvinyl toluene base. The proportionality factor depends on the type and concentration of the primary additive. Secondary additives have only a slight effect on the degree of proportionality: $3P\text{-}\Delta^2$ is somewhat more effective. (ATD)

23505 TEMPERATURE QUENCHING OF LUMINESCENCE EXCITED BY IONIZING PARTICLES IN ZnSAg SINGLE CRYSTALS. Bezel', V. S.; Gavrilov, F. F.; Bronnikov, V. K. Zh. Prikl. Spektrosk., 3: No. 2, 176-8 (1965). (In Russian).

Curves for temperature quenching and scintillation intensity are compared for ZnS(Ag) single crystals activated by α particles, protons, and electrons to various excitation densities. The amplitudes of the scintillation pulses were studied as a function of the excitation density in the tracks of the ionizing particles. ^{239}Pu and ThC–ThC′ were used as sources of α particles. Particles with energies of 2, 3, 4, 5, 6, and 8.77 Mev were produced by varying the vacuum. An EG-2.5 III electrostatic accelerator was used for producing protons with energies of 0.5 and 0.75 Mev. Electron excitation was achieved by irradiation with ^{60}Co γ-rays. An FEU-15B photomultiplier and a 100-channel "Raduga" amplitude analyzer were used for recording the scintillation bursts. The results are given. It was found that in the region of strong quenching (t = 60°C), dI/dX is related to the linear excitation density by a $^3/_2$ law in the interval where $(dI_0/dX)/(dE/dX)$ is independent of dE/dX, where dI_0/dX is the specific amplitude and dE/dX is the linear excitation energy. A theoretical explanation is given for deviation from the $^3/_2$ law at high excitation densities. (ATD)

23506 SCINTILLATION TIME OF CsI(Tl) SINGLE CRYSTALS AS FUNCTION OF ACTIVATOR CONCENTRATION. Vasil'eva, N. N. Zh. Prikl. Spektrosk., 3: No. 5, 470-2(1965). (In Russian).

The time characteristics of the scintillation of CsI-Tl single crystals with activator concentrations from 0.14×10^{-4} to 15.75×10^{-4} mole Tl/mole CsI were studied. The data are presented according to measurements obtained by the polygraphic method. The damping of the scintillations was investigated by the method of an oscillograph, and the warm-up time was studied on an oscillograph. The excitation was induced with a source of gamma radiation of ^{60}Co. An increase in the warm-up time of Tl luminescence with a decrease in its concentration in CsI was found, and the phenomenon was explained by noting that the absorption of the gamma-quantum energy in the grating is not transmitted to the activator instantaneously, but within a period of time which depends on the concentration of Tl. The greater the period of time, the greater the probability of transmission of energy by the centers of luminescence of the pure base or of its conversion into heat. (ATD)

23507 USE OF NUCLEAR EMULSIONS JOINTLY WITH BUBBLE CHAMBERS. Ostroumov, V. I.; Stabnikov, M. V. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 35: 2227(Dec. 1965). (In Russian).

Advantages are pointed out of locating nuclear emulsion targets within bubble chambers. High-energy particles that leave the emulsion and therefore cannot be well identified by nuclear emulsion techniques will be recorded in the bubble chamber, and low energy particles that would not be recorded in the bubble chamber owing to their short ranges will be recorded in the emulsion. Moreover, the tracks in the chamber will serve to locate the event in the emulsion, thus saving much valuable scanning time. It is proposed that the bubble chamber be designed with a central channel for the beam, and that the nuclear emulsion be located within this channel. The proposed technique should be useful for investigating absorption of mesons by nuclei and quasi-elastic scattering of high energy protons and mesons with emission of low energy particles. (ATD)

23508 NEUTRON MONITOR, MODEL 6 (Engineering Materials). (Los Alamos Scientific Lab., Univ. of California, N. Mex.). (CAPE–1357).

6 drawings.

The monitor, which consists of a ^6LiI crystal, is enclosed in a polyethylene sphere. The crystal is coupled to a photomultiplier tube by a light pipe. The instrument is sensitive to a relatively low dose-rate of reactor γ rays with energies greater than 5 Mev. The response of the monitor is sufficiently close to the RBE curve to make it useful as an REM meter. (For details, see TID-4100.) (M.C.G.)

23509 MODIFIED MONITRON /Q-2245/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE–1295).

2 drawings.

A remotely operated instrument for monitoring low-energy β particles is described. It is a modified version of the remote monitron (see CAPE-348) with no basic design changes made. The modifications included reducing the size of the original can to 6 in. in length, and attaching to the end of the can a $^1/_8$-in. galvanized mesh screen 6.25 in. OD and 10 in. long. The chamber, which was fabricated

from linen or paper-filled Bakelite, has 24 pairs of 0.5 in. wide slots equally spaced around it. (For details, see TID-4100.) (M.C.G.)

23510 CHEMICAL DOSIMETERS /Q-2550/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1351).
4 drawings.

A Bausch and Lomb Spectronic-20 was modified to check ~20,000 chemical dosimeter single-phase trichloroethylene-phenol-red ampoules a year, by monochromatic light. The electronic circuit was modified by making minor refinements in the amplifier and by providing a large external meter employing a Zener diode for zero suppression and providing a zero-to-full scale meter reading for the range of ampoules normally measured. Ampoules are fed into a holder, checked, and released to fall into a tray. The holder is equipped with a narrow slit to minimize diffraction and scattering. Optical stability and reproducibility are excellent. (P.C.H.)

23511 DEVICE FOR DETERMINATION OF THE SIMULTANEOUS EMISSION OF SEVERAL NEUTRONS CORRESPONDING TO FRACTIONS OF THE NUMBER OF NEUTRONS EMITTED FROM A NEUTRON SOURCE. Gey, Albert; Jacquesson, Jacques (to Commissariat a l'Energie Atomique). German Patent 1,198,461. Aug. 12, 1965. Priority date Aug. 11, 1961, France.

The device comprises a pulse-type detector connected to an electric element that has two exits. The first exit transfers the pulses directly to a first pulse counter and the second is connected to a second pulse counter via a univibrator, which impresses an artificial, predetermined dead time on the second branch of the device. (Gmelin Inst.)

23512 ARRANGEMENT FOR MEASUREMENT OF A NUCLEAR RADIATION. Janner, Karl (to Siemens-Schuckertwerke AG). German Patent 1,210,093. Feb. 3, 1966. Filed Feb. 27, 1960.

A cylindrical ionization chamber comprising four electrode pairs obtained by subdividing two coaxially arranged metallic cylinders disposed within the chamber housing is enveloped by two rotating radiation shields, which are rotating about the chamber axis. The two rigidly joined shields are arranged opposite each other and shield alternatively neighboring electrode pairs. The electrode pairs are connected in such a way as to generate an output alternating current which is proportional to the intensity of the incoming neutron flux. (Gmelin Inst.)

23513 COUNTER TUBE FOR THE MEASUREMENT OF RADIOACTIVE RADIATION FROM SAMPLES OF VARIOUS GEOMETRIC DIMENSIONS. Erbe, Hermann (to Telefunkten Patentverwertungsgesellschaft mbH). German Patent 1,210,094. Feb. 3, 1966. Filed June 22, 1963.

The counter tube comprises a grounded counter housing and three parallel wires passed through and insulated from the housing. The counter is adjusted to the various dimensions of the samples by varying the counter gas volume which is done by varying the wire voltages. (Gmelin Inst.)

23514 COLLIMATOR WITH A CHANGEABLE FOCUS. Sanbe, Shigehiro (to Keihin Hitachi Engineering Co., Ltd.); Komai, Kenichiro. Japanese Patent 1964-3511. Feb. 24, 1965. Filed Mar. 13, 1963.

An improved collimator for use in a medical scintillation scanner includes a number of tubes (or cylindrical bodies) for the passage of radiation arranged around the axis of radiation from the focus, in the same direction as the axis. Space between the tubes is filled with a fluid radiation shielding material such as mercury. The tubes are held in the container, with their angle to the axis changeable as required, so the focal distance can be changed easily. (NSA of Japan)

Radiation Effects

Refer also to abstracts 23124 and 23760.

23515 (AD-624509) SEMICONDUCTOR DESIGN EFFECTS ON RADIATION RESISTANCE. Quarterly Report No. 2, March 15–June 15, 1965. Gallagher, Brian D.; Honnold, Vincent R. (Hughes Aircraft Co., Newport Beach, Calif. Microelectronics Div.). Nov. 1965. Contract DA-28-043-AMC-00418(E). 35p. CFSTI $2.00 cy, $0.50 mn.

The standard (2N708)-geometry transistors and the special structures including the p-n-p transistor were completed. The entire set of primary photocurrent measurements was carried out under conditions in which the radiation pulse was long in comparison to the minority-carrier lifetime of the material. Preliminary measurements on bar geometries proved to be inconclusive. The equations previously derived for the steady-state distribution of excess carriers were expanded. (D.C.W.)

23516 (AD-625440) RADIATION DAMAGE IN SILICON SOLAR CELLS FROM 4.6-Mev PROTON BOMBARDMENT. Final Report. Statler, R. L. (Naval Research Lab., Washington, D. C.). Nov. 15, 1965. 45p. (NRL-6333). CFSTI $2.00 cy, $0.50 mn.

The radiation damage produced in ten types of silicon solar cells by bombardment with 4.6-Mev protons was studied. A comparative analysis was made of the radio-induced degradation of the cells as a function of short-circuit current, maximum power output, minority-carrier diffusion length, and photovoltaic spectral response. (D.C.W.)

23517 (AD-625533) EFFECT OF TRANSISTOR DESIGN PARAMETERS ON RADIATION RESPONSE (SURFACE EFFECTS). Quarterly Report No. 3, June 15–September 15, 1965. Gallagher, Brian D.; Honnold, Vincent R. (Hughes Aircraft Co., Newport Beach, Calif. Microelectronics Div.). Dec. 1965. Contract DA-28-043-AMC-00418(E). 29p. (ECOM-00418(E)-3). CFSTI $2.00 cy, $0.50 mn.

Concluding experimental irradiation data were taken on four groups of silicon bars, each containing five samples ranging in thickness between 0.003 and 0.012 in. The four groups duplicated surface conditions of mechanical polish, etch, sandblast, and oxide processed into the transistor lots tested in the first two quarters. After irradiation, the effective lifetime of each bar was determined. Surface recombination velocity for each surface treatment was then calculated by plotting the reciprocal of the effective minority carrier lifetime as a function of c^{-2}, where c is the bar thickness. The development of the equations for induced photocurrent for the planar configuration was expanded. (TAB)

23518 (AD-627605) SPACE RADIATION EFFECTS ON HIGH-GAIN LOW-CURRENT SILICON PLANAR TRANSISTORS. Revised Edition. Stanley, Alan G. (Lincoln Lab., Massachusetts Inst. of Tech., Lexington). Oct. 25, 1965. Contract AF19(628)-5167. 85p. (ESD-TDR-65-506). CFSTI $3.00 cy, $0.75 mn.

The availability of silicon planar transistors with d-c gains up to 300 at 10-microamps collector current has made it possible to design circuits with very low power consumption. By irradiating a number of commercial types with 1.5 Mev electrons in different circuit configurations, they were shown to be rather susceptible to space radiation. The most sensitive parameters are leakage current and low current gain. The effect on saturation voltages and on matching characteristics of transistor pairs was found to be minor, as long as the d-c gain did not fall below 10. Under prolonged irradiation at electron fluxes representative of the inner Van Allen belt most transistor types had leakage currents considerably less than 100namp at emitter-collector biases not exceeding 10V. A few types exhibited leakage currents as high as 500 microamps A due to the formation of surface channels. A total dose of 10 to the 15th power e/sq cm reduced the d-c gain in the 5- to 10-microamps A range of most to the transistors to values between 5 and 20. The gain after irradiation was governed by recombination-generation in the base-emitter region, but did not depend significantly on the pre-irradiation gain. Encapsulation of the transistor chip in a dense plastic material proved to be an effective method of preserving

the gain under irradiation with a minimum penalty in weight and volume. (auth)

23519 (AD-631367) GENERALIZED MODEL FOR SEMICONDUCTOR RADIATION RESPONSE PREDICTION. Quarterly Progress Report No. 3, June 15-September 15, 1965. Raymond, J.; Chang, W.; Johnson, R. (Nortronics, Newbury Park, Calif. Applied Research Dept.). Contract DA-28-043-AMC-00423(E). 86p. (ECOM-00423-3). CFSTI $3.00 cy, $0.75 mn.

Work during this period was primarily analytical and devoted to the characterization of the "second-order" effects which significantly influence the transient response of practical transistors. The lumped-model technique was applied to the one-dimensional diffusion models of the junction diode and transistor. It was assumed in all cases that the lumped model parameters were independent of the junction bias voltages and terminal currents. There are three serious deviations from the "ideal" model in a practical transistor: the two-dimensional nature of the base region, the variation of the transistor current gain with emitter current, and the electric field effects induced in the high-resistivity collector region. The lumped-model technique was used to extend the transistor model to include all three effects. (auth)

23520 (N-65-11073) STUDY OF PROTON RADIATION EFFECTS ON SOLAR VEHICLE ELECTRONIC SYSTEM. Latham, Donald C.; Allen, Richard J.; Phalen, Frank (Martin Co., Baltimore, Md.). Sept. 1963. 37p. (NASA-CR-59524; ER-13148). CFSTI $2.00 cy, $0.50 mn.

The radiation effects on the electronic equipment of a solar spacecraft, designed to withstand the effects of solar radiation for 1 year on a mission carrying it to within 0.3 AU of the sun, are considered. The shielding requirements and the component selection criteria based on the estimated environment for the mission are presented. (STAR)

23521 (NASA-CR-54387) ELECTRICAL INSULATION MATERIALS. SNAP-8 RADIATION EFFECTS TEST PROGRAM. VOLUME II. (Lockheed-Georgia Co., Dawsonville). [1964]. Contract NAS5-417. 164p. (ER-7644 (Vol.2)). CFSTI $1.85 cy, $1.00 mn.

For Aerojet General Corp., Azusa, Calif.

Results are presented of the irradiation testing of four types of electrical insulators: sheet insulation, wire, fluids, and statorettes. The specimens were irradiated to 10^8 Rads gamma and 4×10^{13} nvt at 390°F.(W.L.G.)

23522 (UCRL-11936) SOME RADIATION-EFFECTS MEASUREMENTS ON INSULATED-GATE TRANSISTORS. McCaslin, Joseph B.; Carlyle, James (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 16, 1965. Contract W-7405-eng-48. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

P-channel enhancement mode field-effect transistors were irradiated with 7.5-Mev electrons in the range of absorbed dose from 10^4 through 10^8 rads. Another group of devices absorbed 10^6 rads of 7.5-Mev (peak) bremsstrahlung gammas, and a third group received an integrated thermal neutron exposure of 4×10^{14} n/cm^2. Data derived from static measurements are presented which shows post-irradiation shifts in the gate threshold voltage V_{GST}, small signal transconductance g_m, drain-source leakage current I_{DSS}, and gate leakage current I_G. Preliminary data show the effects of postirradiation annealing at elevated temperatures. (auth)

23523 ELECTRON BOMBARDMENT OF MOS CAPACITORS. Zaininger, K. H. (Radio Corp. of America, Princeton, N. J.). Appl. Phys. Lett., 8: 140-2(Mar. 15, 1966).

MOS capacitors were fabricated on 10-Ω-cm n- and p-type Si with a 1000-Å SiO_2 film, and the effects of electron bombardment at 0.1 and 1.0 Mev were investigated. C-V curves were obtained at 1 M Hz, and the results are given in terms of an effective oxide charge. A physical model for the observed effect is presented. (L.B.S.)

23524 TESTING ELECTRICAL COMPONENTS FOR THE SNAP ENVIRONMENT. Long, William G. (Atomics International, Canoga Park, Calif.). Contract AT(11-1)-Gen-8. pp 81-4 of Institute of Environmental Sciences 1965 Annual Technical Meeting. Mt. Prospect, Ill., Institute of Environmental Sciences, 1965.

The testing of some electric connectors and dielectric encapsulating material for use in SNAP systems is summarized. The effects of high temperature, vacuum, and irradiation were studied. (D.C.W.)

23525 NUCLEAR EFFECTS FACILITIES AT WHITE SANDS MISSILE RANGE. Elder, Glenn E. (White Sands Missile Range, N. Mex.). pp 569-72 of Institute of Environmental Sciences 1965 Annual Technical Meeting. Mt. Prospect, Ill., Institute of Environmental Sciences, 1965.

The facilities that are used at the White Sands Missile Range to investigate transient radiation effects are briefly described. Included are the linear electron accelerator facility for the production of electron and gamma pulses, the pulsed neutron generator, and the Fast Burst Facility. (D.C.W.)

23526 A RADIATION HARDENED L-BAND ELEMENTRY TRANSMITTER. Butler, Dan M. (Ling-Temco-Vought, Inc., Dallas, Tex.). pp 454-63 of 1965 International Telemetering Conference Proceedings. [Pasadena, Calif., F G McGavock Associates], 1965.

The development of a nuclear radiation hardened telemetry transmitter, designed for operation in the 1435-1535 Mc region at a nominal 100 W average r-f power is described. The development phases covered consist of design and radiation test of three low power transmitter exciters, design and test of three transmitters, including the 100 W power amplifier and circuit modifications as dictated by radiation test, and change in selection of the final r-f tube. (B.G.D.)

ISOTOPE TECHNOLOGY

General

Refer also to abstract 22880.

23527 (CONF-651206) ISOTOPE SYSTEMS DEVELOPMENT PROGRAM. Seventh Annual Contractors Meeting, December 6–8, 1965. (Division of Isotopes Development (AEC), Washington, D. C.). Mar. 1966. 73p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Activities at a meeting to review progress in development of new principles and techniques for using isotopes are reported. Papers presented at the conference are categorized as basic information, analytical aspects, marine device development, environmental applications, industrial applications, aerospace applications, and national security applications. (J.R.D.)

23528 (N–65–14956) TRITIUM LOSS AT REDUCED PRESSURES IN A HYDROGEN ATMOSPHERE. Shoemake, G. R. (Houston Univ., Tex.). [1964]. 4p. (NASA-CR–60155). CFSTI $1.00 cy, $0.50 mn.

Tritium foils were encapsulated in a glass envelope under a hydrogen atmosphere at various pressures, and tests were made after a month and an additional 3-mo. period to determine the loss in the ionization current. Results show that the loss of activity from the tritium foils due to reduced pressure and hydrogen encapsulation is not significant. Use of these foils as ionizing radiation sources in space flight applications, particularly the gas chromatographic experiments, presents no problems because a single measurement of ionization current prior to sample analysis will permit correction for losses which might occur during transit time in space. (STAR)

23529 (AEC-tr–6466/1) THE USES OF RADIOACTIVE ISOTOPES AND NUCLEAR RADIATION IN THE U.S.S.R. PROCEEDINGS OF THE ALL-UNION CONFERENCE HELD IN RIGA, 12–16 APRIL 1960. VOLUME ONE. GENERAL PROBLEMS CONNECTED WITH THE USE OF ISOTOPES. DEVICES INCORPORATING RADIOACTIVE SOURCES. RADIATION CHEMISTRY. CHEMICAL AND OIL INDUSTRIES. Petrenko, L. I.; Savitskii, P. S.; Sinitsin, V. I.; Kolotyrkin, Ya. M.; Syrkus, N. P.; Romm, R. F. (eds.) Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961). 347p. (IPST-Cat.–1241; CONF-600402 (Vol.1)). Dep. CFSTI $7.00.

Separate abstracts were prepared for each of the 50 papers included. (G.O.Y.)

For abstracts of individual papers see: 22879–22881, 23077–23088, 23239, 23240, 23259, 23428–23432, 23466–23468, 23530–23532, and 23536–23556.

23530 (AEC-tr–6466/1, pp 1-7) STATE AND TRENDS IN THE USE OF RADIOACTIVITY METHODS IN THE NATIONAL ECONOMY. Savitskii, P. S. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1: (1961).

A brief survey of the use of radiation and radioisotopes in the Soviet Union is presented. (D.C.W.)

23531 (AEC-tr–6466/1, pp 26-31) PROSPECTS FOR THE USE OF NUCLEONIC INSTRUMENTS AND RADIATION SOURCES IN THE AUTOMATION OF PRODUCTION PROCESSES IN VARIOUS INDUSTRIES. Sokolov, V. S. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The use of nuclear instruments and radiation sources in agricultural and industrial automation is discussed. (D.C.W.)

23532 (AEC-tr–6466/1, pp 293-6) THE USE OF RADIOISOTOPES FOR CONTROLLING THE FRACTIONATING OF MICROIMPURITIES IN DEVELOPING METHODS FOR PRODUCING EXTREMELY PURE INORGANIC SUBSTANCES. Groshtein, G. I. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Some investigations of the use of radioisotopes for the control of the fractionation of impurities in the production of extremely pure antimony oxide, cobalt oxide, nickel oxide, nickel sulfide, ammonium chloride, and ammonium sulfide are discussed. (D.C.W.)

Industrial Applications

Refer also to abstracts 22753, 23259, and 23432.

23533 (AD–625721) NUCLEAR RADIATION AS A GUIDANCE TOOL. PHASE I. SHORT-RANGE ALL-WEATHER FORMATION CONTROL. Foundational Research Phase Report. Wilcox, G. E. (Naval Air Development Center, Johnsville, Pa.). Dec. 13, 1965. 19p. (NADC-AE–6518). CFSTI $1.00 cy, $0.50 mn.

Several effective helicopter formation control methods were devised, using a gamma radiation source on the leading craft as a guide beacon. The maximum practical range is 1000 feet, limited only by the strength of source, which could be increased at additional potential hazard to maintenance personnel. The accuracy of signal rises rapidly as the range decreases, providing an excellent collision-avoidance capability under all-weather daynight conditions. One such device was built into an aircraft-type chassis and will be operated in the dynamic environment of a helicopter for final evaluation. (auth)

23534 (AECD/Ag/2) CO-ORDINATED PROGRAMME ON THE APPLICATION OF ISOTOPES AND RADIATION IN RICE CULTIVATION, 1964. Final Report. Khan, Abdul Baten; Habibullah, A. K. M.; Rahman, Lutfur; Islam, A. H. M. Habibul (Atomic Energy Centre, Dacca (Pakistan)). Dec. 4, 1964. Contract 147/OB. 17p. Dep. mn.

The effects of the radioisotopes ^{15}N and ^{32}P on rice cultivation were studied. The radioisotopes were used in the fertilizer. The results of early nitrogen application showed an increased grain yield of about 2 to 2.5 times that of East Pakistan average, though it was about 14% above the control yield. Late nitrogen application increased straw yield of the yield sub-plots without affecting the grain yield and also increased the nitrogen content of the plant and P uptake by fertilizer. (P.C.H.)

23535 (ORNL-TM–1505(Pt.1)) SELECTED ABSTRACTS OF NON-U.S. LITERATURE ON PRODUCTION AND INDUSTRIAL USES OF RADIOISOTOPES. Gerrard, Martha; Baker, P. S.; Lafferty, Robert H. Jr. (Oak Ridge National Lab., Tenn.). May 1966. Contract W-7405-eng-26. 27p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Approximately 200 references with abstracts are given to reports, journals, and catalogs published in the Jan.–March 1966 issues of Nuclear Science Abstracts. Selections were limited to those of industrial interest, the word industrial being interpreted to mean work still under development but with potential industrial applications. (P.C.H.)

23536 (AEC-tr–6466/1, pp 8-12) EXPERIENCE IN THE PRACTICAL APPLICATION OF RADIOISOTOPES AND NUCLEAR RADIATION IN THE INDUSTRIAL ESTABLISHMENTS OF THE LATVIAN S.S.R. Gaile, G. I.; Dubovich, V. P. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The development and status of the use of radiation and radioisotopes in the industrial establishments of Latvia are outlined. (D.C.W.)

23537 (AEC-tr–6466/1, pp 13-25) ECONOMIC ASPECTS OF THE INDUSTRIAL APPLICATION OF RADIO-

ISOTOPES AND NUCLEAR RADIATION. Mikheev, G. F. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The economic aspects of the industrial application of radiation and radioisotopes in the Soviet Union are discussed. (D.C.W.)

23538 (AEC-tr-6466/1, pp 39-55) NEW INDUSTRIAL CONTROL AND MEASUREMENT INSTRUMENTS USING RADIOACTIVE ISOTOPES AND RADIATION SOURCES. Zhernov, V. S.; Mamikonyan, S. V. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A number of radiation monitoring, measuring, and spectrometric instruments that were developed for industrial uses are described. (D.C.W.)

23539 (AEC-tr-6466/1, pp 56-61) DEVICES USING RADIOACTIVE SOURCES PRODUCED BY THE TALLIN PILOT PLANT FOR THE MANUFACTURE OF CONTROL AND MEASURING INSTRUMENTS. Lade, G. I.; Shpor, K. K.; Yanushkovskii, V. A. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Some relay-action control and measurements using radiation and radioisotopes are described. (D.C.W.)

23540 (AEC-tr-6466/1, pp 62-6) INSTRUMENTS WITH NUCLEAR RADIATION SOURCES PRODUCED BY THE KHARKOV PLANT FOR THE MANUFACTURE OF CONTROL AND MEASURING INSTRUMENTS (CMI). Gol'din, M. L.; Krivchikov, A. P.; Gorodetskaya, M. S. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The design and use of a gamma-relay level gage are discussed. The applications to coal mining are emphasized. (G.O.Y.)

23541 (AEC-tr-6466/1, pp 67-74) THE DESIGN AND PRODUCTION OF GAMMA-RAY DEVICES AT THE "MOSROENTGEN" PLANT. Sul'kin, A. G. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The design and production of gamma devices for use in flow detection and medical diagnosis and therapy is discussed. (D.C.W.)

23542 (AEC-tr-6466/1, pp 75-81) LOW-VOLTAGE GEIGER-MULLER COUNTERS IN RADIATION DETECTORS FOR PRODUCTION CONTROL. Atopkina, M. S.; Kiryukhin, V. A.; Prager, I. A.; Tumul'kan, A. D.; Chaikovskii, V. G.; Yanushkovskii, V. A. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Several types of low-voltage Geiger-Müller counters are described. Some radiation detection devices that use these G-M counters are discussed. (G.O.Y.)

23543 (AEC-tr-6466/1, pp 82-99) ALPHA-, BETA-, GAMMA-, AND NEUTRON-RADIATION SOURCES FOR CONTROL AND AUTOMATION IN PRODUCTION PROCESSES. Fradkin, G. M.; Kulish, E. E. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A survey of particle and radiation sources for use in industrial automation and control in the Soviet Union is presented. The interactions of particles and radiations with matter are discussed, together with several types of sources. (D.C.W.)

23544 (AEC-tr-6466/1, pp 100-5) SOME TYPES OF ^{90}Sr BETA SOURCES. Bogdanov, N. I.; Zakharova, K. P. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The design, preparation, and properties of various types of beta sources using ^{90}Sr are discussed. (D.C.W.)

23545 (AEC-tr-6466/1, pp 106-10) SAFETY PROBLEMS CONNECTED WITH THE WIDE APPLICATION OF RADIOACTIVITY DEVICES. Iordan, G. G.; Furman, K. S.; Neiman, T. G. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Some safety problems connected with the industrial use of particle and radiation sources are discussed. (G.O.Y.)

23546 (AEC-tr-6466/1, pp 114-20) THE USE OF STANDARD SOURCES OF BETA RADIATION AND BREMSSTRAHLUNG IN INDUSTRIAL CONTROL INSTRUMENTS. Bogdanov, N. I.; Dambert, N. A.; Tumul'kan, A. D.; Yanushkovskii, V. A. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Several standard beta and bremsstrahlung sources are described, and their use in industrial control instruments is discussed. (G.O.Y.)

23547 (AEC-tr-6466/1, pp 121-3) DEVELOPMENT OF RADIOACTIVITY INSTRUMENTS AT THE VEF PLANT. Svilans, M. P. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The use of radioisotopes in a plant for the manufacture of electronic equipment is outlined. A temperature controller, voltage regulator, voltage stabilizer, current-density regulator for electroplating, and devices for testing radio-receiver transformers and telephone plugs are discussed. (D.C.W.)

23548 (AEC-tr-6466/1, pp 124-7) STANDARDIZATION OF RADIOACTIVITY THICKNESS GAGES OF SHEET MATERIAL AND COATINGS. Barabanov, B. V.; Vainu, E. Ya.; Znamenskii, V. M.; Shpor, K. K.; Yanushkovskii, V. A. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The use of radiometric thickness gages in the control and measurement of the thickness of coatings and sheets is discussed. Some specific gages are considered including an all-purpose thickness gage which is described in some detail. (D.C.W.)

23549 (AEC-tr-6466/1, pp 256-9) AN AUTOMATIC FLOAT-TYPE CONDENSATE DRAIN USING A RADIOACTIVE SOURCE. Smirnov, A. N.; Utkin, V. V. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Two-stage gas scrubbing is used in the Shebelinsk gas field. A device that is designed to control the valves at the first and second scrubbing stages is described. The device emits signals denoting the upper and lower condensate levels in the storage tanks in the first and second scrubbing stages and denoting the state of the valves. (D.C.W.)

23550 (AEC-tr-6466/1, pp 268-71) EXPERIENCE IN USING A RADIOACTIVITY DENSITY GAGE IN MONITORING THE FLOW OF OIL PRODUCTS IN PIPELINES. Furman, K. S.; Yakunin, V. V. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The design and use of a radioactivity density gage in monitoring the flow of oil products in pipelines is discussed. (G.O.Y.)

23551 (AEC-tr-6466/1, pp 278-82) A DEVICE FOR THE AUTOMATIC CONTROL OF POLYETHYLENE SHEET THICKNESS. Manoilov, V. E.; Loznovskii, Yu. Ya.; Osipov, N. I.; Mel'gren, E. Kh.; Denisov, S. F. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A radiometric thickness gage that was developed for use in automatically controlling the thickness of polyethylene sheets is described. A ^{204}Tl beta source is used in the gage. (D.C.W.)

23552 (AEC-tr-6466/1, pp 283-7) INTRODUCING RADIOMETRIC CONTROL METHODS IN THE CONSECUTIVE TRANSFER OF OIL AND OIL PRODUCTS OVER PIPELINES. Votlokhin, B. Z.; Dorogochinskii, A. Z.; Mel'nikova, N. P. Translated from Radioakt. Izotopy i

Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A tracer technique and a radiometric installation for determining the interface between different oil products in a pipeline are described. (D.C.W.)

23553 (AEC-tr-6466/1, pp 297-309) APPLICATION OF RADIOISOTOPES IN THE CONTROL OF CHEMICAL PROCESSES. Romm, R. F. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The use of radioisotopes in the control of chemical processes is discussed. The control of extraction columns using gamma density gages, the measurement of solid-particle concentration in fluid-bed systems, the desiccation of chlorine, the automatic monitoring and control of an alcohol chlorination column in the production of DDT, an automated circuit for the chlorination of kerosene in the production of sulfonol, and the automatic control of crystallization processes are considered in some detail. (G.O.Y.)

23554 (AEC-tr-6466/1, pp 310-15) CONTROL OF UNIFORMITY OF GLASS-SMELTING BATCH ACCORDING TO NATURAL RADIOACTIVITY. Shelyubskii, V. I. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

A method for measuring the uniformity of a glass-smelting batch by monitoring the distribution of naturally occurring ^{40}K is discussed. (G.O.Y.)

23555 (AEC-tr-6466/1, pp 316-27) TRENDS IN THE USE OF SOME TYPES OF LEVEL GAGES AND LEVEL INDICATORS. Experience in Testing and Practical Application. Veksler, M. A. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

The testing of several types of radiometric level gages and indicators is summarized. Brief descriptions of the devices are given. (D.C.W.)

23556 (AEC-tr-6466/1, pp 328-37) INVESTIGATING THE OPERATIONAL PROPERTIES OF LUBRICATING OIL ADDITIVES WITH RADIOACTIVE TRACERS. Zaslavskii, Yu. S.; Shor, G. I. Translated from Radioakt. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: (1961).

Some techniques that were developed for the investigation of the properties of lubricating oil additives under operating conditions are discussed together with some tests of additives. A radiometric method of evaluating the formation of carbon deposits in engines is described. (D.C.W.)

23557 PENICILLINASE STERILIZATION WITH GAMMA RADIATION OF ^{60}Co. Chaikovskaya, S. M.; Pochapinskii, V. I.; Torbochkina, L. I.; Mogilevchik, L. E.; Tebyakina, A. E. (National Science Research Inst. of Antibiotics, Moscow). Antibiotiki, 9: 930-2(Oct. 1964). (In Russian).

Experiments were conducted on penicillinase samples from two strains of Bacillus cereus (569 and 5B). Sample preparation is described. To determine the minimal sterilizing dose the penicillinase samples were exposed to ^{60}Co γ irradiation in doses of 1.5, 2, and 2.5 Mrad. The sterility of the irradiated penicillinase samples was verified by plating the samples in thioglycollate agar, with subsequent incubation at 37 and 25°C and an observation period of 8 days. It was determined that the minimal sterilizing dose for such penicillinase preparations was 2.5 Mrad. The enzyme activity of various penicillinase samples sterilized by γ radiation did not decrease significantly, irrespective of the form of the penicillinase preparation. (BBB)

23558 IMPROVEMENTS IN THE MEASUREMENT OF THICKNESSES BY NUCLEAR METHODS. Boulanger, R. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), No. 58, Suppl., 4-6(Mar.-Apr. 1966). (In French).

Measurements of the thickness of glass, plastic materials, and metals using γ rays from ^{241}Am are described. Improvements in the method by absorption and by backscattering of the radiation are indicated. (J.S.R.)

23559 IRRADIATION OF AGRICULTURAL PRODUCTS AND FOODSTUFFS IN FRANCE. Vidal, P. Bull. Inform. Sci. Tech. (Paris), No. 99, 43-7(Dec. 1965). (In French).

The development of the work carried out in France since 1954 in the field of the irradiation of foodstuffs and agricultural products with a view to their preservation is traced. Several examples of the application of this method are given. (auth)

23560 RADIOISOTOPES IN PRODUCTION ENGINEERING. Putman, J. L. (Wantage Research Lab., Eng.). Chem. Ind. (London), No. 31, 1359-61(July 31, 1965).

Isotope techniques in production engineering practice and still more, developed for use in factories and workshops, are reviewed. Gamma source strengths of the order of 1000 C are necessary to compete for speed with the x-ray installations and for these activities the lead housing and source manipulation become cumbersome. Paper manufacturers use transmission gages to measure the thickness of a product continuously as it is manufactured. A thickness gage, based on the proportion of β particles that pass through the paper web from a source on one side to a detector on the other, gives a continuous indication of mass per unit area and enables corrections to be made at once. Beta sources are the most widely used and afford a choice of particle energy that permits their use for thicknesses from about 1 to 1200 mg/cm^2 equivalent to thin tissue paper on the one hand or $^1/_{16}$ in steel on the other. The use of suitable gamma sources extends this range up to several inches of steel or its equivalent in other materials. Various gages are in use, which rely on the back scattering of radiations from a surface to emerge on the same side as the source. One application is to coal mining machinery, in which the back-scattering of low energy γ rays from the floor beneath a mechanical coal cutter is used to measure the thickness of the coal floor and to guide the cutter to within an inch of bedrock. An instrument for on-stream analysis, adaptable to the assay of a wide range of specific elements, is based on the fluorescent x rays emitted by a target when it is struck by ionizing radiation. These correspond to the return of disturbed electrons to the ground state of their parent atoms and their energies are characteristic of the elements from which they arise. Individual constituents of a mixture, or an alloy, can be measured at concentrations down to 0.1%. The widest use of radioactive tracers is for research into the nature and kinetics of chemical processes. A survey of direct financial gains from the introduction of radioisotope techniques in the manufacturing industries indicated that the gross annual savings in 1961 were from 11 to 14 million £ for a total annual outlay of £1.9 million including all equipment and services. Ninety-four % of these savings were attributed to process control using radiometric gages and nondestructive testing by γ radiography. (BBB)

23561 ANALYSIS OF PINE-TREE EXTRACTS BY MEANS OF β RADIATION. Sandermann, W.; Schweers, W.; Hoheisel, H. Chim. Ind. (Paris), 90: 58-60(July 1963). (In French).

Measurement of the density of wood, before and after solvent extraction of rosin, by the absorption of β particles is shown to be faster and more accurate than older methods of analysis. The necessary equipment includes a scintillation detector and counter, source of β particles, and a system for moving the samples. The β source, 20 mC of ^{90}Sr, is put in a Be chamber, which provides for a narrow beam of radiation. The wood sample is moved at a constant speed past the source. The β particles passing through the sample are registered on the scintillation counter with the impulses recorded on a graph moving at the same speed as the wood. Since the absorption of the β particles is proportional to the density of the wood, the density of extractable materials in wood can be determined by measuring β absorption before and after solvent extraction. For this procedure it is necessary that the wood samples be of uniform thickness. A study of pine (Pinus maritima) sections was made using this method. For the previous five years the tree was

tapped by the bark-chipping method. Analysis by β radiation transmission showed a heavily resinified zone behind the tapping scar. After extraction, analysis showed a drop in the wood density, including a large drop in the zone behind the scar. (BBB)

23562 EFFECTS OF GAMMA RADIATION ON BANANAS. Ferguson, W. E. (Canada Dept. of Agriculture, Ottawa); Yates, A. R.; MacQueen, K. F.; Robb, J. A. Food Technol., 20: 105-7(Feb. 1966).

A study was undertaken to determine whether ^{60}Co γ radiation would control fungal spoilage in bananas and whether any organoleptic and physical side-effects were produced. Anthracnose spoilage in bananas becomes apparent during the ripening process and is caused by the fungus Gloeosporium musarum. Under commercial ripening conditions, no fungal growth generally penetrated from the skin into the pulp at 100 and 150 Krad doses. At doses of 100 krad or higher, bananas showed serious skin discoloration varying from gray-green to russet. The effect of irradiation on flavor closely paralleled the effect on color. The off-color fruit and skin-splits characteristic of bananas irradiated in closed containers at dose levels of 100 krad or higher were rated unfavorably by the taste panel. Lower doses had no noticeable effect on flavor except that ripening, and therefore full flavor, was retarded. Analyses for ascorbic acid showed a lower concentration in irradiated than in control samples, with the concentration diminishing slightly with increasing dose levels. Fungicidal doses to bananas on the stalk retarded ripening. Results strongly indicate the need for well-ventilated irradiation facilities. (TCO)

23563 IRRADIATION PRESERVATION OF FRESHWATER FISH. I. EXTENSION OF REFRIGERATED STORAGE LIFE OF FRESH YELLOW PERCH FILLETS. Emerson, J. A.; Kazanas, N.; Greig, R. A.; Seagran, H. L.; Kempe, L. L. (Bureau of Commercial Fisheries Technological Lab., Ann Arbor, Mich.). Food Technol., 20: 108-10(Feb. 1966).

Preliminary sensory tests conducted on yellow perch fillets (Perca flavescens) irradiated to doses of 0.2, 0.3, 0.4, 0.5, 0.7, 1.0, and 1.5 Mrad indicated that levels as high as 0.7 Mrad could be used before objectionable irradiation flavors were imparted to the product. Selected for subsequent storage tests were levels of 0.3 and 0.6 Mrad. Fillets were air-packed in Cryovac clear plastic bags and placed in 1-qt glass jars charged with crushed ice to maintain 33°F during irradiation. Samples were irradiated with a 2500-C ^{60}Co source at a dose rate of 52 krad/hr. Storage temperatures of 33 and 42°F were selected as representing optimum vs relatively unfavorable storage conditions. Results indicated the storage life of unirradiated fillets held at 33°F to be 10 days, whereas irradiation to levels of 0.3 and 0.6 Mrad, respectively, increased storage life 4- and 5-fold. Storage at 42°F accelerated spoilage rate greatly reducing storage life at 33°F by 50%. Results of microbiological and chemical tests agreed well with sensory panel evaluations. It is concluded that yellow perch fillets are suitable to the irradiation-pasteurization process. Storage life at 33°F can be extended significantly by a dose of 0.3 Mrad, with only little damage to initial quality. (BBB)

23564 FIELD EXPERIENCE IN MEASURING OIL CONTENT, LITHOLOGY AND POROSITY WITH A HIGH-ENERGY NEUTRON-INDUCED SPECTRAL LOGGING SYSTEM. Hoyer, W. A.; Rumble, R. C. (Humble Oil and Refining Co., Houston, Tex.). J. Petrol. Technol., 17: 801-7(July 1965).

An oil well logging system based on a nuclear means of identifying elements was developed. A complete logging system, consisting of a pulsed high-energy neutron generator, a gated sodium iodide crystal, photomultiplier gamma detector, and surface equipment for recording gamma spectra, is described. By pulsed operation of the generator and simultaneous gating of the detector, only those prompt γ rays resulting from high-energy neutron reactions are detected. The detector remains off while the neutrons are being slowed sufficiently by formation elements for capture reactions to occur. In practice, the detector remains on about 5 μsec and off about 995 μsec. The prompt γ rays are detected and collected to form γ energy spectra for analysis of elements present in the formation. Typical results from 27 field tests and interpretation of the data are discussed. Since γ rays induced by the pulses of 14-Mev neutrons have energies characteristic of the elements bombarded, analysis of a formation's spectrum furnishes direct identification of the formation lithology and its contained fluids. Oil content is determined from the ratio of carbon and oxygen γ rays, lithology from the responses of key elements (silicon in sandstones, magnesium in dolomites, and sulfur in anhydrites), and porosity from the moderation of neutrons. Formation shaliness, water salinity, hole and casing sizes, and type of fluid in the well do not seriously affect responses of the logging system. An appendix is given, which describes the γ spectral response in various formations. (BBB)

23565 RADIATION PRODUCTION AND ITS PROSPECTS IN YUGOSLAVIA. Dvornik, Igor (Inst. Ruder Boskovic, Zagreb). Nukl. Energ., No. 5-6, 27-31(1965). (In Slovak).

The introduction of radiation into industrial practices for cross linking of polyethylene, the synthesis of ethylbromides, radiation treatment of semiconductors, sterilization of medical appliances, and sterilization or pasteurization of foodstuffs is discussed. By the economic effect and the quality of products achieved, the processes introduced are successfully competing with conventional processes. The problems of technology, economics of irradiation, and the problems of radiation protection are being solved. The application of radiation-chemical processes, especially in the production of improved polymers and fibers, and to some extent for chemical synthesis, is discussed. The radiation-chemical processes may simplify the development of the technological process itself. A favorable economic condition for the development of radiation production in Yugoslavia was created by the possibility of choosing, when new products are introduced, between the conventional and the radiation process. The possibility of utilizing a radiation plant (gamma sources or electronic accelerators) simultaneously for the processing of very different items is considered. The first radiation plant is, therefore, to be built as a multipurpose facility, the economic justification of which rests on the technological and economic solution of production (sterilization of medical appliances, pasteurization of foodstuff, treatment of potatoes, wheat, etc.), and the design of which permits the introduction of the treatment of polymer products and of other processes. The basic economic factors are presented and the capacity, role, and possible engagement of laboratories in various institutes analyzed. (auth)

23566 EFFECT OF GAMMA RADIATION ON THE RIPENING OF BARTLETT PEARS. Maxie, E. C.; Sommer, N. F.; Muller, Carlos J.; Rae, Henry L. (Univ. of California, Davis). Contract UCD-34P80. Plant Physiol., 41: 437-42(Mar. 1966).

Gamma radiation at doses of 300 Krad or more inhibits the ripening of Bartlett pears (Pyrus communis L.). Immediately after irradiation there is a transitory burst of C_2H_4, which subsequently declines in fruits subjected to inhibitory doses. Ethylene production associated with ripening begins at the same time in unirradiated fruits and those subjected to noninhibitory doses, but the latter produces much more C_2H_4 at the climacteric peak. Fruits subjected to inhibitory doses produce low levels of C_2H_4 unless subjected to exogenously applied C_2H_4, whereupon they produce enough of the gas to induce ripening in unirradiated fruits. Pears subjected to 300 and 400 Krad of gamma rays did not ripen even when held in a flowing atmosphere containing 1000 ppm of C_2H_4 for 8 days at 20°. It is concluded that the action of gamma rays on Bartlett pears involves both an inhibition of C_2H_4 production and a decreased sensitivity of the fruit to the ripening action of the gas. Ripening of Bartlett pears is inhibited by gamma radiation only when applied to preclimacteric fruit. (auth)

23567 RADIO-ISOTOPES ET RAYONNEMENTS DANS L'INDUSTRIE ET LA TECHNIQUE. Aspects Economiques et Techniques. (Radioisotopes and Radiations in Industry and Technology. Economic and Technical Aspects). Cahier d'Information du Bureau EURISOTOP 3. Serie: Monographies 1. Brussels, Bureau EURISOTOP–EURATOM, 1965. 96p. 50 F. B. 5 F.F.

Eleven articles on the economic and technical aspects of the use of radioisotopes and radiations in industry and technology were compiled. The topics discussed are: production of artificial radioelements, application of radioisotopes in the electrical industry, use of radioisotopes in metallurgy, radioisotopes in the chemical and pharmaceutical industries, radioisotopes in the textile industry, principles and applications in activation analysis, utilization of nuclear energy in agriculture and the food industry, problems caused by the use of radioactive tracers in hydrology, radioisotopes in internal medicine, the use of radioisotopes and radiations in the mechanical industry, and present and future research problems in the industrial application of radioisotopes. (J.S.R.)

23568 LIGHT ELEMENTS SIMULTANEOUS ANALYZER BY X-RAY EMISSION METHOD USING ALPHA- AND X-RAY SOURCES FOR CEMENT RAW MIX CONTROL. Uchida, K. (Ube Industries, Ltd., Japan); Tominaga, H.; Imamura, H.; Miwa, H. Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-68/6, 20p. (CONF-651023-20). ORINS.

From Symposium on Radioisotope Instruments in Industry and Geophysics, Warsaw.

An x-ray emission analyzer using radioisotope sources was developed for control of mixing of raw materials for cement where light elements (Mg, Al, and Si) must be determined in a sample matrix of higher atomic number elements (mainly Ca and a little Fe). In order to analyze the lower elements with good S/N ratios, alpha sources (^{210}Po) of 10 mC × 2 are used, and for the higher elements, especially iron, bremsstrahlung sources (H^3/Zr) of 3 C × 2 are used together. Both sources are covered with aluminium or mica foil of 1.5 mg/cm^2. The measuring head is kept in a vacuum, and a sample is exchanged without breaking its vacuum through an exchanging room. Two sets of a gas-flow proportional counter are used with and without an aluminum filter on each side window. Both counters detect x rays generated from one sample. Amplified pulse-height spectra of their outputs are stabilized by feedback control. In analysis, a fused-glass sample is used to eliminate differences in grain size and mineralogical characteristics. Results of measurements are corrected of matrix effect using an electronic computer for the control of raw materials feeds. The analysis appeared to be more accurate than usual fluorescent x-ray analysis, and the use of the analyzer is considered to be favorable mainly because of rapidity in measurement and economy. (auth)

23569 DETERMINATION OF THE ASH CONTENTS OF COAL, THICKNESS GAUGING OF GLASS, PLASTICS AND METALS WITH ^{241}Am γ-RAYS. Trost, A. (Laboratorium Prof. Dr. Berthold, Wildbad, Ger.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-68/24, 14p. (In French). (CONF-651023-19). ORINS.

From Symposium on Radioisotope Instruments in Industry and Geophysics, Warsaw.

The possibility of measuring the ash contents of coal to an accuracy of ±0.5% by using back scattering of low-energy γ rays is considered. The iron content, which could influence the measurement, is sufficiently constant for any individual coal mine. By using ^{241}Am, in connection with an automatic drift compensation of the scintillation counter, a long-time stability corresponding to ±0.1% ash content was achieved. A scintillation counter can also be used to measure the thickness of steel plates during the rolling process by the absorption method. ^{137}Cs γ radiation is used in combination with a ratemeter, which works up to 10^6 cps. For a distance of 1500 mm between source and detector, using a time constant of 1 sec RC, a precision of ±0.05 mm is routinely obtained up to 40 mm steel thickness and of ±0.3 mm up to 100 mm steel thickness. The same measuring system, however, with an ^{241}Am source, can be used to measure steel thicknesses of 3 mm with a precision of ±0.01 mm using a time constant of 0.1 sec. If the steel thickness is 6 mm, the measuring slit 150 mm, and the time constant 1 sec, the precision obtained is ±0.02 mm. For substances of low atomic number (glass, rubber, and plastics) high precision thickness gaging with ^{241}Am γ radiation is possible using the back-scattering method. With proper beam geometry the indication is independent from distance changes of ±5 mm. If scanning across the width of the material is required, the mechanical setup is considerably simpler for the back-scattering method as compared to absorption. Measurement with ^{241}Am is especially important for thicknesses greater than the practical range of β rays as between 0.5 and 5 g/cm^3. The required dose rates are considerably smaller and the shielding easier than with the back-scatter apparatus using ^{137}Cs. With a prototype for the thickness gaging of 3 mm glass a precision of ±0.003 mm was obtained with a time constant of 2 sec. (auth)

23570 METHOD FOR PRODUCING A PIG-LUNG-PARASITE IMMUNIZING SUBSTANCE. Isoda, Masae; Okazaki, Juichi. Japanese Patent 1964-612. Jan. 14, 1965. Filed May 22, 1963.

A new vaccine is proposed for immunizing pigs against lung parasites. Larvae of the lung parasite are irradiated at about 6000–20,000 R and inactivated to the extent that they are not strongly effective biologically. The resulting substance, i.e., inactivated larvae, are administered to pigs by mouth. (NSA of Japan)

Power Application

See *also* ENGINEERING — Space Propulsion

23571 (AD–624684) A RADIOISOTOPIC POWER SUPPLY FOR THE SUNBLAZER SPACE PROBE [Thesis]. Perkins, David R. (Massachusetts Inst. of Tech., Cambridge). Aug. 1965. Contract AF33(608)-1249. 74p. CFSTI $3.00 cy, $0.75 mn.

A preliminary investigation of the application of a radioisotopic power source in conjunction with the Sunblazer space probe of the MIT Center for Space Research resulted in the design of a 12-watt electric power source which weighs 5.16 pounds. The fuel consists of 526 g of PuO_2 dispersed in graphite. The fuel is contained in a capsule made of Haynes-25 Alloy which has been designed to contain the isotope under all possible launch abort conditions. The heat from the isotope is converted to electric power by passing it through 40 silicon-germanium thermoelectric couples. The output of 12 w is produced at 2.66 v and an overall efficiency of 5.80%. The radiation of waste heat is accomplished by means of an aluminum radiator which is always directed toward cold space. The probe is oriented by means of solar radiation pressure. (TAB)

Separation and Production

See *also* CHEMISTRY — Separation Processes and Procedures

23572 (SGAE-PH–32/1965) DIE SEPARATION VON STABILEN ISOTOPEN DER SELTENEN ERDEN. (Separation of Stable Isotopes of the Rare Earths). Formann, E.; Lugmair, G.; Ruedenauer, F.; Wotke, H.; Viehboeck, F. P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). 1965. 19p. Dep. mn.

The production of rare earth stable isotopes at the Seibersdorf Reactor Center is described. The initial difficulties encountered in the mass spectrometric separation are discussed, and the operational conditions of the ion source for the various rare earth elements are reported. Results obtained for Gd and Yb are tabulated. (J.S.R.)

23573 ATMOSPHERIC ^{14}C CONTENT DURING THE PAST THREE MILLENNIA IN RELATION TO TEMPERATURE AND SOLAR ACTIVITY. Bray, J. R. (Dept. of Scientific and Industrial Research, Palmerston North, New Zeal.). Nature, 209: 1065-7(Mar. 12. 1966).

Carbon-14 climatic relationships during the past three millennia are discussed on the basis of ^{14}C data on 193 samples, all but 4 of which were samples from tree boles dated by ring analysis. Corrections were made for deviations in $^{13}C/^{12}C$ ratio. Measurements on Sequoia gigantea accounted for 139 dates and measurements on Agathis australis boles and Picea engelmannii boles in forests in British Columbia, Canada accounted for most of the other samples. The relationship of temperature and sun spot activity to ^{14}C activity is discussed. The data show a decreasing trend in ^{14}C activity from about 1200 B.C., the earliest date included, to the tenth century A.D., followed by a rise that was especially rapid after 1300 A.D., and which culminated in the 15th to 17th centuries. A subsequent decline occurred to the mid-19th century, when burning of fossil fuel vitiated results of further measurements. The two periods of high ^{14}C activity, 1200 to 500 B.C. and 1300 to 1860 A.D., were coincident with the two major periods of lower temperatures and glacial advance since the Hypsithermal. Other data also suggest an inverse relationship between ^{14}C activity and temperature. Analysis of data on the cosmic ray flux due to solar activity indicates a decrease in ^{14}C activity with increasing solar activity. A possible positive correlation of solar activity and terrestrial temperature is given indirect support by the interrelationship of these factors with ^{14}C activity. (C.H.)

23574 TRANSFORMATION THEORY OF THE SEPARATION CASCADES. V. THE COARSELY STEPPED CASCADE. Troetsch, E.; Dickel, G. (Univ., Munich). Nukleonik, 8: 74-80(Feb. 1966). (In German).

The method with which in previous work the optimum dimensions of individual rectangular cascades could be determined was generalized and the case of installation composed of several rectangular cascades was treated. As essential magnitudes, two reduction factors for length and width and the utilization degree occur in each partial cascade. These magnitudes are functions of the initial and final concentration of the partial cascades and the final concentration of the total installation. Numerical values of the reduction factors were derived by which one could calculate any cascade with sufficient accuracy. (tr-auth)

23575 ENRICHMENT OF DEUTERIUM. Klein, Friz; Bar-Eli, Kedma. Canadian Patent 719,200. Oct. 5, 1965. Priority date Aug. 25, 1961, Israel.

As a variation of the bithermal isotopic exchange process, the use of hydrogen with a primary or secondary amine in the presence of a substituted alkali-metal catalyst is proposed. Advantages claimed are a cheaper plant of smaller dimensions employing lower pressures, and having an exchange rate ten times that of the ammonia-hydrogen process. Suitable feed materials are alkyl amines with up to five carbon atoms. Flow rates and deuterium enrichment at various stages are shown. Three examples are given, which provide an indication of the operating parameters. (F.S.A.)

23576 A NEW METHOD FOR SEPARATING AND CONCENTRATING DEUTERIUM. Enomoto, Ryuichiro (to Japan Pure Hydrogen Co., Ltd.). Japanese Patent 1964-11728. June 11, 1965. Filed Aug. 17, 1962.

When deuterium and light hydrogen permeate a Pd-alloy membrane, their permeating velocities are different. Thus, the deuterium can be continuously separated and concentrated. The method is very economical, compared with other methods. The Pd-alloy contains below 40% of Ib-group elements and 0.1–20% of VIII-group elements of the periodic table. (TCO)

MATHEMATICS AND COMPUTERS

23577 (AD-625328) AN IMPROVED STEPWISE REGRESSION ANALYSIS PROCEDURE. Wilcoxson, W. L.; Wohlever, J. R. (Naval Civil Engineering Lab., Port Hueneme, Calif.). Dec. 6, 1965. 56p. (TN-N-775). CFSTI $3.00 cy, $0.50 mn.

Stepwise regression analysis is a least squares method for estimating an empirical linear relationship between variables. This method is implemented by the computer program STRAP with FORMAT, Version 2, for the IBM 1620 Card or Paper Tape Data Processing System with 20,000 positions of storage and no special features. (TAB)

23578 (WERL-8844-10) DIPOD SAMPLING: A METHOD FOR STUDYING THE DISTRIBUTION OF FINITE PARTICLES. Hooke, Robert (Westinghouse Research Labs., Pittsburgh, Pa.). June 17, 1965. Contract NObs 78844. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

For Bettis Atomic Power Lab., Pittsburgh, Pa.

The distribution of finite particles was investigated. The problem is to test whether a collection of particles shows a tendency toward attraction or repulsion other than that caused by their physical size. Since there seem to be various non-equivalent ways of describing a "random" distribution of such particles, and since these ways lead to intricate problems of geometric probability, a different approach is used. This approach is through the sampling procedure, and specifically a procedure is used involving two sample points a fixed distance d apart. This pair is called a dipod, and by studying the results of dipod sampling for various values of d, one can obtain a test for the presence of attraction or repulsion of particles. (auth)

23579 INTRODUCTION TO THEORIES OF INTEGRATION OVER FUNCTION SPACES. Streit, L. (Univ., Hamburg). Acta Phys. Austr., Suppl. II, 2-21(1965).

An introduction to the kind of problems, theorems, and computational devices one encounters with theories of functional integration is presented. Topics discussed are the Wiener integral in relation to integral equations, differential equations, changes in variables, Fourier-Wiener transforms, the Feynman integral, and Hilbert space integrals. (B.G.D.)

23580 REDUCTION OF MULTIPLE TO SINGLE HILBERT SPACE INTEGRALS. Rzewuski, J. (Univ., Wroclaw. Inst. of Physics, Polish Academy of Sciences, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 14: 45-9(1966).

It is shown that multiple Hilbert space integrals over a number N of functions $q^a(x)(a = 1,2,\ldots,N)$ of points x of an arbitrary n-dimensional space can always be replaced by a single Hilbert space integral over one function q(x) defined on the same space of points x. The theorem is formulated and proved for the case of Hilbert space integrals with Gaussian measure. Possible generalizations are discussed. (L.B.S.)

23581 ON THE SELF-ADJOINTNESS OF THE OPERATOR $-\Delta + V$. Limic, N. (International Atomic Energy Agency, Trieste, Italy). Commun. Math. Phys., 1: 321-7 (1966). (IC-65-69)

The essential self-adjointness of the operator $-\Delta + V$ is proved, where V is a potential whose main property is the high singularity and repulsiveness at the origin. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstracts 22879 and 24490.

23582 (BMI–1765) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING FEBRUARY 1966. Keller, Donald L. (Battelle Memorial Inst., Columbus, Ohio). Mar. 1, 1966. Contract W-7405-eng-92. 31p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Progress is reported in studies on reactor materials and components, fuels, PuN–UN fuel materials, development of a portable smoke photometer, coated-particle fuel materials, and corrosion of materials used in the fluidized-bed fluoride-volatility process. (W.L.G.)

23583 (COO–1198-358) THE SCIENCE OF MATERIALS. Annual Progress Report, 1965–1966. (Illinois Univ., Urbana. Materials Research Lab.). Apr. 15, 1966. Contract AT(11-1)-1198. 69p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Brief summaries are given of the results of investigations on: dislocation and surface barriers, solid state phase transformations, annealing of cold-worked metals, strain energy in martensitic transformations, electronic specific heat of alloys of transition elements with nontransition elements, use of very high pressure to investigate the structure of matter, first order phase transformations in solids, nuclear magnetic resonance studies, properties of noble gas crystals, properties of ^3He below 0.01°K, point defect-dislocation interactions, the impurity conduction band in Si and Ge and magneto-optic effect of the R center in KCl, conduction mechanisms in semiconducting glasses, mechanical and surface behavior of crystals, anharmonic effects in solids, defect and electronic properties of solids, electron and nuclear magnetic resonance, defects in refractory metals and alloys, and radiation damage. (W.L.G.)

23584 (EURAEC–1552) USE OF PLUTONIUM AS A FUEL IN NUCLEAR REACTORS. Quarterly Report No. 7, (Societe Belge pour l'Industrie Nucleaire, Brussels). Dec. 1965. Contract 001-64-1-TRUB. 79p. (EUR–2694; BN–6512-02). Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

An attempt was made to correlate the homogeneity of the plutonium in vibratory-compacted fuel elements with the powder characteristics and method of loading. Calculations and measurements were made of the effects of irradiation and plutonium heterogeneity on the neutron flux distribution along the length of fuel elements. Fuel elements were evaluated during irradiation as to the temperature distribution and its dependence on the power released by the fuel and the heat transfer properties of the cladding geometry. The neutron physics study of the 15.4 and 22 mm pitch $UO_2-PuO_2-H_2O$ lattices performed on the Thetis lattice was completed. A critical approximation with cylindrical and square geometries, and a variable poisoning measurement were made for these two lattices. Pulsed and source ejection measuring methods were used and gave similar results. The slope and linearity for the function $\alpha = f$ (number of rods) made it easy to estimate the prompt critical mass. (W.L.G.)

23585 (GEAP–3771-18) HIGH PERFORMANCE UO_2 PROGRAM. Quarterly Progress Report No. 18, July–September 1965. Lyons, M. F. (ed.) (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Nov. 1, 1965. Contract AT(04-3)-189. 60p. (EURAEC–1584). Dep. mn. CFSTI $3.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

A metallic ingot located at the bottom of a UO_2 fuel column was removed from the surrounding fuel. The ingot density was found to be high (11.3 gm/cm^3) and the electrical resistance nearly zero, providing proof of the metallic character of the ingot. After separating out Ru, the remaining major isotopic activity was ^{125}Sb, a relatively low-yield fission product. Chemical tests showed that Mo was a major constituent of the ingot, while U and Pu were nearly absent. Analysis of limited data on hyperstoichiometric UO_2 indicates that the thermal conductivity was not significantly different from that measured for stoichiometric material. Postirradiation examination of a thermal conductivity capsule revealed several potential explanations for an electrical short. The temperature sensor was disassembled, rebuilt incorporating design changes to avoid these electrical weak spots, and recalibrated. The third isothermal fission gas release capsule IFFGE No. 3 was irradiated with the isothermal sample operating steady state at 1900°C. The capsule performance was flawless during irradiation, but postirradiation examination showed the sample W cladding had leaked. The fission gas analysis for IFFGE No. 1 was completed. The release fraction is 0.8% based on all of the fuel in the capsule, i.e., both isothermal sample and heater-insulator fuel. Analyses are underway to refine the release value and determine the fraction attributable to the isothermal fuel sample. Postirradiation strength properties determined on tensile coupons were analyzed and correlated with the corresponding pre-irradiation values. Results are reported for Zircaloy-2, Incoloy, and Inconel after irradiation at 350°F to 1.2×10^{21} and 2.4×10^{21} nvt (E > 1 Mev), and testing at room temperature, 600, and 1100°F. The reaction of I with unautoclaved Zircaloy-2 foil is uniform, linear, and varies with the I pressure, raised to the 0.4 power. The temperature dependence was erratic. The reaction with autoclaved Zircaloy-2 is nonuniform with severe pitting, demonstrating the importance of the oxide film. A single irradiated cladding sample had a shorter induction period, but a slower reaction rate than the unirradiated monitor sample at the same temperature. At the I concentration in these experiments, which is comparable to the stable I inventory in an operating fuel rod, the reaction rate is sufficiently rapid to penetrate a typical cladding thickness in a few hr. The fact that this reaction does not occur indicates the I within an operating fuel rod is probably not free, but bound to some other element. The fission product and Pu distribution data from high performances UO_2 fuel rods were analyzed and correlated. These rods operated with intermediate and incipient central melting. No evidence of axial Cs migration was observed in the rod operated with incipient central melting, which suggests the axial migration of the volatile fission products is a direct consequence of melting. The axial fission product distributions corresponded to the integrated average neutron flux profile during irradiation. The rod operated with intermediate central melting showed evidence of convective mixing and homogenization of fission product concentrations with the molten core. Superimposed on the convective mixing there appears to be a radial segregation effect within the molten zone for Pu and Cs. This segregation is hypothesized to be from rejection of impurities from the UO_2 as it recrystallizes. (W.L.G.)

23586 (UCRL–12427) PLUTONIUM AND URANIUM AS ENGINEERING MATERIALS. Henry, Charles R. (Lawrence Radiation Lab., Univ. of California, Livermore). Feb. 26, 1965. Contract W-7405-eng-48. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A review of current design possibilities using Pu and U and their principal alloys as materials in engineering design is presented. Mechanical and physical properties are summarized. Fabrication and joining techniques are presented, including forging, plating, machining, and welding. Also discussed are the peculiar difficulties and hazards of packaging and handling assemblies containing these materials. (auth)

23587 INFLUENCE OF OXYGEN CONTENT ON THE RECOVERY OF COLD-WORKED TANTALUM. Schlaet, F.; Koethe, A. (Deutsche Akademie der Wissenschaften zu Berlin, Dresden). Acta Met., 14: 425-30(Mar. 1966). (In German).

On cold-worked tantalum the recovery occurring at approximately 400°K was investigated for different oxygen contents by measuring the Snoek damping, the electric resistivity, and the dynamic E-modulus. The electric resistivity recovering in this stage increased linearly with the oxygen content. Simultaneously a decrease of the Snoek damping and a recovery of the amplitude dependent modulus defect was observed. The experimental results can be interpreted in terms of the migration of oxygen atoms and their association at dislocations. (auth)

23588 SHORT-TERM OXIDATION OF URANIUM IN AIR IN THE RANGE 250 TO 325 deg C. Evans, C. I. L. (Central Electricity Generating Board, Berkeley, Eng.). J. Inst. Metals, 94: 187-9(May 1966).

Studies were made to determine whether a parabolic initial stage exists or not in short-term oxidation of U in air at 250–325°C. The methods used are described. The results showed that the oxidation follows a parabolic law during the early stages up to at least 325°C, and it is suggested that, as a whole, the oxidation may be described by a paralinear relation. The activation energy for the oxidation, 33 kcal/mole, supports the view that diffusion of oxygen ions across the UO_2 film is the rate-controlling process. (P.C.H.)

23589 CHEMICAL ETCHANT FOR PuO_2. Shadden, Virginia (Los Alamos Scientific Lab., N. Mex.). J. Nucl. Mater., 10: 215(May 1966).

The etchant reveals grain boundaries and twins in PuO_2 and distinguishes between PuO_2 and β-Pu_2O_3 in sintered compacts. The specimen is ground through 600 grit paper and lapped with 14.5 μm Al_2O_3 and Linde A in CCl_4 on vibratory polishers. It is etched with a solution consisting of equal volume proportions of concentrated HF and HNO_3. A drop of the etchant is placed on the polished surface to form a meniscus and then heated by placing the specimen about 1 in. from a 250-w infrared lamp until the etchant starts to vaporize (about 15 sec). The specimen is then moved to a position about 3 in. from the lamp for 50 sec and then allowed to cool for 30 sec with the meniscus intact before rinsing with CCl_4. Rinsing is followed by ultrasonic cleaning in CCl_4 to remove all traces of the etchant. (W.L.G.)

23590 BRIGHT FIELD GRAIN STRUCTURE ETCH FOR DELTA PHASE STABILIZED PLUTONIUM. Hays, D. D. (Battelle Northwest Lab., Richland, Wash.). J. Nucl. Mater., 10: 216-20(May 1966).

The development of a bright field grain structure etch usable on delta-phase-stabilized Pu alloys regardless of their metallurgical condition is described. (W.L.G.)

23591 ZIRCONOTHERMIC REDUCTION OF EUROPIUM PENTOXIDE. Gvelesiani, G. G.; Bezarashvili, Sh. M.; Nadiradze, A. A. (Georgian Inst. of Metallurgy, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR, 37: 121-6(1965).

Results from an experimental study of zirconothermic reduction of Eu_2O_3 under vacuum are presented. Experiments were conducted on briquettes weighing 1.5-2 g and made of mixed powders of C, Eu_2O_3, and Zr. The yield of Zr increased at 1000–1300°C (with the increase of the molar ratio of Zr/Eu_2O_3 to 3.75), and then remained constant. The reaction was explosive at the start and slowed down after a few minutes. Raising the temperature increased the rate of reaction at its early stages. Experimental data are presented graphically. It was found that increasing the pressure during the formation of briquettes decreased the yield of Eu and the rate of reaction, while reducing the particle size of Zr from 1 + 0.5 to 0.25 + 0.1 mm had the opposite effect. Lowering the particle size of Eu_2O_3 from 2 to 0.05 mm increased the percent yield of Eu from 13 to 85. The reaction was found to involve the solid phases of the ingredients without forming any intermediate products. The optimal pressure was 10^{-2} mm Hg. The process was inhibited by vaporization of Eu and by diffusional retardation. (CFSTI)

23592 THERMOCHEMISTRY OF REACTIONS IN THE SYSTEM U_3O_8–UO_2–Me. Kiss, S. J.; Ristic, M. M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 511-16 of STI-PUB-109(Vol.2).

A critical thermochemical analysis of reactions in some UO_{2+x}-Me systems ($U_3O_8-UO_2-Al$, $U_3O_8-UO_2-Cr$, $U_3O_8-UO_2-Mg$, and $U_3O_8-UO_2-Ti$) was made. By a preliminary differential thermal analysis of reactions in the above systems the temperature at which the reactions take place was determined and it was proved that the reactions in the systems are exothermal. By analysing the three-component $U_3O_8-UO_2-Me$ systems the reactions which, from the thermodynamic aspect, are possible in these systems were determined. Taking into account the thermochemical values of the reactant and products, and the basic laws on reactions in solid phase, it was found that reduction of U_3O_8 to UO_2 with metals is the dominant process in the systems investigated. Changes of the free energy of the reductions were calculated from the results of differential thermal analysis and thermochemical data on reactants and products. X-ray investigations of the reaction products of the systems confirmed the results of the thermochemical studies. It was also shown that reaction in the $U_3O_8-UO_2-Ti$ system forms a compound of UO_2 and TiO_2. (auth)

23593 PREPARATION OF URANIUM MONONITRIDE BY THE REACTION OF URANIUM DIOXIDE WITH CARBON AND NITROGEN. Imoto, S.; Stoecker, H. J. (Kernforschungsanlage, Juelich, West Ger.). pp 533-45 of STI-PUB-109(Vol.2).

Uranium mononitride has recently attracted increasing interest as a potential high-temperature nuclear fuel. For laboratory use the mononitride has been prepared from the elements, but a suitable method for industrial production would involve the reaction of uranium dioxide with carbon and nitrogen, following the theoretical equation: $UO_2 + 2\ C + \frac{1}{2}\ N_2 = UN + 2\ CO$. However, as the hypothetical uranium monoxide (UO) shows an appreciable solubility in both UN and UC, one obtains not the pure mononitride but a solid solution of the composition $UN_{1-x-y}C_xO_y$. The results of thermodynamic calculations are presented, and these show the range of the one-phase region as a function of temperature and partial pressures of CO and N_2 as well as the maximum obtainable purity of UN under different conditions. Assumptions for the nonregular behavior of the solid solution are discussed. Analogous calculations were carried out for the solid solutions $UN_{1-x}C_x$ and values for the stability range and the expected purities were obtained. Experimental results are presented which are in good agreement with the calculated values. (auth)

23594 METHOD FOR THE PREPARATION OF ALUMINUM–URANIUM ALLOYS. Zappi, Daniel Alfredo (to Comision Nacional de Energia Atomica). German Patent 1,212,304. Mar. 10, 1966. Filed Aug. 19, 1963.

Aluminum–uranium alloys were prepared by the reduction of uranium fluoride with an excess of aluminum using a flux containing alkali chloride. The surface of the aluminum melt is covered by a mixture of sodium chloride, potassium chloride and sodium fluoride, and the gaseous uranium hexafluoride is introduced below the surface of the aluminum melt at a bath temperature of 850°C. (Gmelin Inst.)

23595 METHOD FOR PREPARING A SAMPLE MATERIAL FOR ELECTROLYTIC POLISHING. Kikuchi, Seishi (to Japan Atomic Energy Research Inst.). Japanese Patent 1964-9725. May 19, 1965. Filed Dec. 18, 1962.

When obtaining a sample (metal) in a "hot laboratory" by remote handling for testing its structure, the material is electrolytically polished. To prepare the sample for polishing, a hole is made through a plastic block which is not an electric conductor and solidifies upon heating. This hole is filled with a suitable mixture of an electrically conducting powder and a heat-solidifying plastic powder. The

sample material in the form of a plate is placed over the filled hole; the material is then pressed onto the block by hot working. (NSA of Japan)

23596 METHOD FOR PRODUCING ELECTROLYTICALLY TITANIUM, ALUMINUM, THORIUM, AND ZIRCONIUM METALS. Nakano, Kenji Japanese Patent 1964-10681. May 29, 1965. Filed Sept. 21, 1961.

Pure metals or mixtures of titanium, aluminum, zirconium, and thorium are produced by electrolysis in an aqueous solution or a non-aqueous medium of respective metal salts, which have been reacted with urea and stabilized against water. (TCO)

Corrosion

Refer also to abstract 23767.

23597 (COO–1319-30) INVESTIGATION OF CRACKING IN STAINLESS STEEL FUEL ELEMENTS. Period Covered: December 1964–August 1965. Staehle, R. W. (Ohio State Univ. Research Foundation, Columbus). Oct. 25, 1965. Contract AT(11-1)-1319. 82p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

An investigation was undertaken to elucidate the nature of a cracking mechanism whereby a number of stainless steel clad fuel elements failed in experimental assemblies in the VBWR. The experimental investigation included optical metallography, microhardness, Huey tests, anodic polarization, chemical analysis, and electron microscope fractography. An attempt was made to rationalize observations on the basis of a cracking mechanism which was either entirely mechanical or chemical-mechanical. Such an approach was desirable in order to assess whether the cracking was applicable only to the specific experiment or to a broad range of reactor types and materials. Because of the lack of critical information, no definite conclusion regarding either mechanism was obtained. While the evidence available at this time seems to favor a chemical-mechanical or stress corrosion cracking type of mechanism, it is believed that a sufficiently good case exists for the mechanical idea that it cannot be discounted. Recommendations are given regarding specific experiments which should be performed to reach a credible conclusion. (auth)

23598 (COO–1319-34) A STUDY OF THE MECHANISM OF STRESS CORROSION CRACKING IN THE IRON–NICKEL–CHROMIUM ALLOY SYSTEM. Quarterly Report, September 17, 1965–December 16, 1965. Staehle, R. W. (Ohio State Univ. Research Foundation, Columbus). Jan. 19, 1966. Contract AT(11-1)-1319. 41p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Studies to determine the mechanism of stress corrosion cracking in Fe–Cr–Ni alloys continue. Surface preparation is shown to have a significant effect on the reproducibility and the scatter of results. A mechanically abraded surface gives the least scatter. Electron metallography of thin films exposed to boiling $MgCl_2$ shows that pure Ni exhibits transgranular dissolution when stressed and random pitting when non-stressed. When compared to established trends of chloride cracking, which have shown repeatedly that pure Ni does not crack, the data indicate that while film-rupture-dissolution does occur, it is not a critical step in the process of cracking. Tensile properties on 18 alloys are reported over a temperature range 25 to 650°C. (auth)

23599 (COO–1319-36) MICROTOPOLOGY OF STRESS CORROSION CRACKING. Smith, T. J.; Staehle, R. W. (Ohio State Univ. Research Foundation, Columbus). Mar. 1966. Contract AT(11-1)-1319. 14p. (CONF-660514-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From 3rd International Conference on Metallic Corrosion, Moscow.

Thin films of four iron–nickel–chromium base alloys were examined in the electron microscope, exposed to boiling $MgCl_2$, and examined again. Compositions were as follows (atomic per cent): Fe–15Ni–20Cr, Fe–15Ni–20Cr–1.5Si, Fe–15Ni–20Cr–0.1N, Fe–45Ni–20Cr. Each alloy was treated to obtain structures in the annealed, strained, and aged condition. Examination of specimens exposed to boiling $MgCl_2$ showed that stress exerts an important influence on the mode of cracking. In the absence of stress, attack tended to take the form of pitting; whereas, with stress the attack was highly oriented with the pitting being aligned in parallel crystallographic directions. The alloy containing phosphorus exhibited pitting having definite geometric shapes. Defect structure in the thin films appeared to have little correlation with established trends in cracking susceptibility nor with the mode of dissolution of thin films. (auth)

23600 (GA–7005) EXPERIMENTS ON THE REACTION OF HIGH-TEMPERATURE STEAM WITH PYROLYTIC-CARBON-COATED (Th,U)C_2 PARTICLES. Burnette, R. D.; Dixon, J. M.; Lofing, D. R.; Zumwalt, L. R. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Mar. 28 1966. Contract AT(04-3)-167. 34p. (CONF-660409-1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Libby/Cockcroft Meeting on Graphite Chemistry, Harwell, Eng.

Experiments on the compatibility of pyrolytic-carbon-coated U, Th fuel particles with high-temperature steam are discussed. Oxidation rates and particle failure times for both irradiated (i.e., catalyzed) and unirradiated (i.e., noncatalyzed) pyrolytic-carbon-coated (Th, U)C_2 particles at temperatures from 1000 to 1400°C and using steam partial pressures of 0.025 and 0.22 atm in flowing He are presented. A comparison of particle failures is given where particles are steam oxidized, unsupported, and protected by sacrificial graphite. (auth)

23601 (GEAP–4837) SODIUM MASS TRANSFER. XXI. 1964 TEST RUN REPORTS. Lockhart, R. W. (comp.) (General Electric Co., San Jose, Calif. Advanced Products Operation). Oct. 1965. Contract AT(04-3)-189. 236p. Dep. mn. CFSTI $6.00 cy, $1.25 mn.

A compilation of the reports for seven test runs in six test loops completed during 1964 is presented. The six test loops were of identical configuration though fabricated of different materials. The materials used were type 316 stainless steel, $2\frac{1}{4}$ Cr–1 Mo alloy steel, and 5 Cr–$\frac{1}{2}$ Mo–$\frac{1}{2}$ Ti alloy steel. These materials were used in various combinations for the hot and cold legs of the corrosion loops. (W.L.G.)

23602 (ORNL–3913, pp 53-73) AQUEOUS REACTORS. (Oak Ridge National Lab., Tenn.).

Research on materials corrosion and chemical behavior in reactor environments is reported. Results of investigations concerning high-temperature aqueous solutions are included along with information on interactions of water with particulate solids. (J.R.D.)

23603 (ORNL-TM–1437) A STUDY OF LEAD AND LEAD-SALT CORROSION IN THERMAL-CONVECTION LOOPS. Tolson, G. M.; Taboada, A. (Oak Ridge National Lab., Tenn.). Apr. 1966. Contract W-7405-eng-26. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Thermal-convection loop tests of several structural alloys were operated using circulating molten Pb. Screening tests were run to evaluate Croloy $2\frac{1}{4}$, ASTM A-106 carbon steel, AISI-type 410 stainless steel, and Nb–1% Zr. Two of the test loops contained surge tanks in which fluoride salts, Nb–1% Zr alloy, and graphite were placed in contact with the Pb to determine the compatibility of these materials in a direct-cooled lead system. All of the steel loops tended to plug in the cold regions because of formation of dendritic crystals of Fe and Cr. The hot-leg attack consisted of general surface removal with a few large pits extending to a greater depth. The Nb–1% Zr alloy showed no measurable attack; however, Nb crystals were found in the cold leg of a loop which operated 5000 hr at 1400°F with a ΔT of 400°F. (auth)

23604 (RFP–744) THE CORROSION OF UNALLOYED AND ALLOYED PLUTONIUM IN MONOBROMOBENZENE AND FREON-113 FLUOROCARBON. Dringman, M. R. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.).

May 14, 1965. Contract AT(29-1)-1106. 5p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The specimens were exposed for 26, 72, and 140 hr at 25°C. For the 26-hr period, monobromobenzene was 2.5 times more corrosive to the unalloyed Pu and 2 times more corrosive to the Pu-1 Ga alloy than the Freon-113. (W.L.G.)

23605 (SC-RR-65-615) AN EXPERIMENTAL STUDY OF THE EFFECT OF OXYGEN ON TANTALUM ABLATION IN A HYPERTHERMAL PLASMA TUNNEL. Marshall, B. W. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1966. Contract AT(29-1)-789. 56p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

Data obtained from exposing tantalum models in the simulated re-entry environment of a hyperthermal arc tunnel are discussed. The rate of mass removal was found to be a function of the oxygen partial pressure in the 1800–2700°C temperature range. The oxygen tantalum ratio was found to be close to the composition TaO and calculated mass removal rates based on this composition are compared with the measured values. Engineering methods for calculating tantalum re-entry ablation are developed and presented. (auth)

23606 (UJV-1453/65) RADIACNI ODOLNOST ROZTOKU DUSITANU SODNEHO JAKO INHIBITORU VODNI KOROZE OCELI. (Radiation Resistance of $NaNO_2$ Solution Used to Inhibit Corrosion of Steel in Water). Zajic, V.; Rypar, V. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1965. 26p. Dep. mn.

The radiation resistance of aqueous sodium nitrite, used to inhibit the corrosion of steel in solution, was studied in the VVR-S research reactor. After 50 hr in the reactor the sodium nitrite concentration of the solution decreased to a constant level and remained at that level for another one-hundred hours. The constant level depended on the initial concentration, but was always sufficient to inhibit corrosion (i.e., greater than 1 g/liter) when the initial concentration was greater than 7 g/liter. In some cases there was a slight regeneration of nitrite, with the $NaNO_2$ concentration rising slightly after reaching a minimum value. For the VVR-S fluxes the radiation intensity had little effect on the results. The volume of the solution likewise was not significant. The nature of the gas phase affected the results somewhat, with hydrogen and oxygen being better than nitrogen in protecting the sodium nitrite from the irradiation. (TTT)

23607 OXIDATION OF ATJ GRAPHITE BY LOW CONCENTRATIONS OF WATER VAPOR AND CARBON DIOXIDE IN HELIUM. Blakely, J. P.; Overholser, L. G. (Oak Ridge National Lab., Tenn.). Carbon, 3: 269-75 (Dec. 1965). (ORNL-P-1291).

The rates of reaction of a spherical specimen of ATJ graphite with low partial pressures of carbon dioxide and water vapor were determined in flowing helium at a total pressure of 1 atm. The rates were obtained from continuously recorded weight changes and from intermittent analyses of the effluent gases. The effects of temperature, flow rate, partial pressure of oxidant, and burnoff were examined. Activation energies of ~50 kcal/mole were observed for the H_2O–graphite system in the temperature range from 775 to 925°C at 110 and 460 vpm (parts per million by volume). Values of ~60 kcal/mole were found for the CO_2–graphite system in the same temperature range using CO_2 concentrations of 550 and 1000 vpm. The apparent order of the two systems was found to be between 0.6 and 0.7 at 875°C in the concentration ranges of 50 to 1000 vpm of CO_2 and 30 to 760 vpm of H_2O. Strong and about equal retardation of the H_2O–graphite reaction was noted upon the addition of either H_2 or CO. The CO_2–graphite reaction was also found to be strongly retarded by either CO or H_2. Differences in the results obtained for ATJ graphite from those found previously for Speer Moderator-2 graphite are noted. (auth)

23608 ORDER OF REACTION FOR THE OXIDATION OF NUCLEAR GRAPHITE IN MOIST OXYGEN–NITROGEN MIXTURES. Lewis, J. B.; Dix, J.; Murdoch, R. (Atomic Energy Research Establishment, Harwell, Eng.). Carbon, 3: 321-2 (Dec. 1965).

The order of reaction for the oxidation of nuclear graphite in moist nitrogen–oxygen mixtures was determined. Results are presented graphically. The reaction rates and activation energies were about the same as with dry gases, the order of the reaction was 0.65, a little higher than before, and the CO/CO_2 ratio was slightly lower. Neither of the differences was very great and could be due to a different impurity level in the graphite used. (F.J.H.)

23609 THE INFLUENCE OF IMPURITIES ON THE OXIDATION OF URANIUM IN CARBON DIOXIDE BETWEEN 450 DEG AND 650 DEG C. Stobbs, J. J.; Whittle, I. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Mater., 10: 160-8 (May 1966).

The kinetics and morphology of the oxidation of two grades of uranium, which contain small quantities of carbon, aluminum and iron as major impurities, are described. In general, the shapes of the weight gain curves are similar to those for pure uranium, but at 450°C the occurrence of localized oxidation at carbide inclusions leads to earlier acceleration in the oxidation rate. At higher temperatures localized oxidation becomes less important and the aluminum and, to a lesser extent, the iron lower the oxidation rate. Nevertheless, oxidation is controlled throughout by the diffusion of O^{2-} ions through a thin layer of uncracked UO_2 next to the metal. (auth)

23610 REACTION BETWEEN TANTALUM METAL AND URANIUM DIOXIDE. Amato, I.; Colombo, R. L.; Balzari, A. M. Petruccioli (FIAT, Turin). J. Nucl. Mater., 10: 190-2 (May 1966).

Mixtures of UO_2–5 wt % Ta powders were cold pressed and vacuum induction-heated in W crucibles at 2150°C for times ranging from 5 min to 10 hr. A dark grey phase formed after 5 min at temperature, but disappeared after longer times. It is proposed that at high temperatures the stable composition of $UO_{2.00}$ is oxygen-defective so that free oxygen is released and reacts with Ta. The disappearance of the tantalum oxide is explained as the consequence of the small amount formed, the high volatility of the oxide, and the large porosity of the bodies. (W.L.G.)

23611 COMPATIBILITY OF TUNGSTEN WITH MOLTEN UO_2. Eash, D. T. (Los Alamos Scientific Lab., New Mex.). J. Nucl. Mater., 10: 196-7 (May 1966). (LA-DC-7563).

Powdered UO_2 was vacuum sealed at $\sim 10^{-4}$ torr in W crucibles and heated at 3000°C for 168 hr. The regions of most rapid attack appeared to be at grain boundaries or sub-grain boundaries. Large amounts of free α-U were detected as a grain boundary network and as dispersed particles within the UO_2 matrix. No evidence of a reaction was found for a test conducted at 2750°C. Whether the heat treatment was conducted in a He or H_2 atmosphere had no apparent effect on the resulting products. From this it was concluded that the U was probably formed by dissociation of the UO_2 with the free O_2 diffusing into the W. The microstructures indicate that the U dissolves in the UO_2 and precipitates out during cooling. (W.L.G.)

23612 HYDROFLUORINATION KINETICS OF DOPED URANIUM DIOXIDE. Ellis, W. P. (Los Alamos Scientific Lab., New Mex.). J. Nucl. Mater., 10: 212-14 (May 1966). (LA-DC-7363).

Separate mixtures of high-purity UO_2 with 1, 3, and 5% (cationic mole basis) Y_2O_3, MgO, CaO, and BaO and 5% ThO_2 were fused inductively in an Ar atmosphere in a W susceptor. The hydrofluorination kinetics of UO_2 at 231 to 285°C were not greatly altered by the addition of impurity cations in this concentration range. Both CaO and MgO retarded the rate of hydrofluorination, Y_2O_3 increased the rate, and 5% ThO_2 had no significant effect. It appears that BaO either boiled off or formed separate phases rather than a solid solution. In regard to the rate-limiting transport mechanism, at least one of two alternatives is correct: either the impurity cations did not upset the equilibrium

concentration of the relevant point defects in the fluoride product or else the rate of hydrofluorination is not limited by diffusion of ions through a thermally activated point-defective sublattice in the UF_4 layer. (W.L.G.)

23613 STUDY OF COMPATIBILITY IN THE ZIRCALOY-2–ALUMINIUM, ZIRCALOY-2–COPPER AND ZIRCALOY-2–NICKEL SYSTEMS. Brossa, F.; Hubaux, A.; Quataert, D.; Schleicher, H. W. (EURATOM-CCR, Ispra, Italy). Mem. Sci. Rev. Met., 63: 1-10(Jan. 1966). (In French).

A description of the deposition and heat-treatment processes is given. The examination of diffusion couples and an interpretation of the results are presented. The formula giving the growth of the diffusion zones is given and the determination by calculation of the parameters of the formula is described. (auth)

23614 OXIDIZABILITY OF NIOBIUM AND ITS ALLOYS DURING ALLOYING. Ul'yanov, R. A.; Tarasov, N. D. Soviet J. Non-Ferrous Metals, 76-8(Apr. 1964).

Alloying of Nb with small additions of Ti, Cr, V, Mo, Ta, Re, Zr, Ir, La, Be, Si, and B followed by vacuum rolling, vacuum annealing, and oxidizing at 1100°C is described. Heat resistance and oxidation rates as affected by alloying elements were analyzed. The alloying elements were classified in terms of their capacity to stabilize the Nb_2O_5, which induces internal stresses due to differences in molecular volumes of Nb and Nb_2O_5. (Rev. Metal Lit.)

23615 A CONTRIBUTION TO THE MECHANISM OF DISSOLUTION AND DIFFUSION OF OXYGEN IN ZIRCONIUM. Doerffler, W. W. (Atomic Energy of Canada Ltd., Chalk River. Swiss Federal Inst. for Reactor Research, Wuerenlingen, Switzerland). pp 373-90 of STI-PUB–109(Vol.2).

The diffusion of oxygen in zirconium was investigated with special regard to a dependence on the concentration of oxygen and on the structural properties of the metal. From determinations of the rates of decrease of thickness of anodically and thermally formed oxide films in a vacuum at temperatures up to 600°C as a function of time, and the local distribution of oxygen between oxide–metal interface and metal interior by microhardness measurements, and by using the proton activation of ^{18}O, the following can be shown: That the rate of diffusion of oxygen increases with increasing oxygen content in the concentration range where the solution of oxygen in the metal departs from ideality. Oxygen diffuses preferentially in regions of lattice distortions, such as grain boundaries, dislocations, and the close neighborhood of the previously dissolved oxygen itself. That the release of free energy of oxygen dissolution is a maximum when an oxygen atom becomes dissolved in an octahedral hole of the metal lattice where the surrounding zirconium atoms are at their equilibrium positions, and that the activation energy for oxygen migration to another equal octahedral hole also has a maximum. The release of free energy for oxygen dissolution and the activation energy for oxygen migration in regions of lattice distortions are, therefore, lower. That diffusion of oxygen is dependent on the thermal and mechanical pretreatments of the metal: this, as the oxidation-rate controlling step, in the low temperature range, is discussed. (auth)

23616 IMPROVED OXIDATION RESISTANCE OF ZIRCONIUM RESULTING FROM ADDITION OF SMALL AMOUNTS OF COPPER. Loriers, H.; Darras, R.; Baque, P. (Centre d'Etudes Nucleaires, Saclay, France). pp 391-405 of STI-PUB–109(Vol.2). (In French).

The process by which the addition of small amounts of copper improves the resistance of zirconium to oxidation by pressurized carbon dioxide between 600 and 700°C is described. The resulting alloys, particularly that with 2.5% copper, seem to offer interesting possibilities as cladding or structural materials for the fuel elements of reactors of the heavy water–carbon dioxide type. The corrosion of zirconium by carbon dioxide amounts essentially to oxidation, in which two processes are involved: the building up of a layer of monoclinic zirconia, through which oxygen diffuses by migration of the anionic vacancies; and the dissolution and diffusion of oxygen, which penetrates into the metal. The combination of gravimetric data and measurements of the thickness of the oxide layers permits evaluation of the two corresponding diffusion coefficients. The calculation was extended, by analogy, to the case of binary zirconium–copper alloys with a concentration of copper less than or equal to 4% by weight. Comparison of the results obtained shows that the apparent diffusion coefficient of oxygen in the oxide layer that is formed decreases as the copper content of the alloy in question increases; as regards the apparent diffusion coefficient of the oxygen in the alloy, though this is only slightly modified at 600°C, at 700°C it too decreases when the copper content is increased to 2.5%. The improved oxidation resistance associated with slowing down of the diffusion processes results, in particular, in prolongation of parabolic-type kinetics whereas, in the case of non-alloyed zirconium or other alloys, cracking in the oxide layer rapidly leads to linear oxidation kinetics as a result of the phenomenon of peeling. (auth)

23617 THERMOCHEMICAL PARAMETERS OF THE SECOND PHASE OF URANIUM DIOXIDE OXIDATION AT LOW TEMPERATURES. Stamenkovic, I. D.; Kiss, S. J.; Ristic, M. M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 431-4 of STI-PUB–109(Vol.2).

A critical analysis was made of the thermochemical data on two-phase oxidation of uranium dioxide and intermediary U_3O_7 oxide existing in the literature. The preliminary experiments, made by the dynamic thermal method, showed a series of disadvantages which prevented reproducibility and would not allow satisfactory accuracy of measurement. For this reason subsequent measurements were made at constant temperatures between 300 and 400°C, on an apparatus adapted for dynamic analysis. Throughout the work U_3O_7 oxide of known composition and purity was used. An attempt was made to measure the heat of formation of U_3O_8 from U_3O_7 by the classical isothermal calorimetric method. The heat of formation and the heat capacity of U_3O_7 were calculated from the experimental results obtained. An approximate standard entropy value of U_3O_7 is also given. The practical value of the parameters obtained for U_3O_7 is indicated. (auth)

23618 INVESTIGATION OF THE CORROSION PROPERTIES OF YTTRIUM. I. EFFECT OF pH ON THE CORROSION AND ELECTROCHEMICAL BEHAVIOR OF YTTRIUM. Altovskii, R. M.; Fedotova, A. G.; Korolev, S. I. Zashchita Metal., 2: 52-6(Jan.-Feb. 1966). (In Russian).

The rate of yttrium corrosion in chloride and nitrate aqueous solutions decreased with increased pH of the medium which is explained by the predominant slowing down of the anode processes. The ions NO_3^- and particularly Cl^- decrease the corrosion resistance of yttrium. The corrosion of yttrium at 25°C in aqueous solution at pH ≤ 10 proceeded both with hydrogen and oxygen depolarization and in solutions with pH ≥ 11 with oxygen depolarization. The electrode potentials in aqueous solutions with pH > 3 appeared to be potentials of the film-time type. (tr-auth)

23619 THE KINETICS, MICROSTRUCTURES, AND MECHANISM OF INTERNAL OXIDATION: ITS EFFECT AND PREVENTION IN HIGH-TEMPERATURE ALLOY OXIDATION. Rapp, Robert A. (Ohio State Univ., Columbus). 79p. (CONF-650325–2). ORINS. Gmelin, AED-CONF-65-037-4.

From National Association of Corrosion Engineers, 21st Annual Meeting, St. Louis.

The role of internal oxidation in the oxidation of alloys is reviewed and evaluated, and five alloy types represented by Ag–In, Cu–Be, Ni–Cr, Nb–Zr, and Cu–Zn–Al are considered in detail. Internal oxidation is a diffusion-controlled process for which the kinetics may be predicted from diffusion equations. Except for oxidations involving the formation of extremely stable solute oxide precipitates or oxidations at temperatures allowing only minimal solute mobility, the experimentally measured kinetics are in agreement with the calculated rates. The radius of a spherical internal oxide precipitate is expected to vary

directly with the depth at which the precipitate is formed and inversely with the oxygen solubility at the external surface. On exceeding a critical solute content in a given binary alloy system, the occurrence of internal oxidation of the solute is replaced by the formation of an external scale of the solute metal oxide. A reduction in the oxygen content at the surface or the introduction of deformation into the surface of the alloy can reduce the solute content required for the transition from internal to external oxidation. In most cases, the prevention of internal oxidation by the formation of a compact surface layer of the solute oxide results in a reduction of the oxidation rate of an alloy. When internal oxidation of a solute occurs in combination with external scale formation, the morphology of the precipitates in the microstructure of the oxidized alloy is determined by both the precipitation conditions and the mode of external scale formation. Internal oxide precipitates can affect both the mechanism and kinetics of external scale formation. (auth)

Fabrication

Refer also to abstracts 23072, 23640, and 24734.

23620 (DP-996) ATTACHING RIBS TO ZIRCALOY FUEL ASSEMBLIES BY ELECTRON BEAM WELDING. Ferrara, Anthony S.; Glasgow, Forrest F. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Feb. 1966. Contract AT(07-2)-1. 23p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A guidance system, jigs, and fixtures were developed for electron beam welding longitudinal ribs to either the inside or the outside of 10-foot-long, thin-walled Zircaloy-2 tubing, approximately 3 inches in diameter, or for welding ribs to the outer cladding of otherwise finished, rigid fuel elements. A demonstration run of 26 thin-walled Zircaloy-2 housing tubes indicated that the equipment and techniques were fundamentally satisfactory, and that with minor improvements the equipment would probably also be adequate for welding external ribs on fuel elements. (auth)

23621 (EURAEC-1548) WELDING OF VERY THICK STEELS. Final Report. (Ghent Rijksuniversiteit (Belgium)). SOUDOMETAL, S. A., Brussels (Belgium)). [1965]. 135p. (EUR-2690). Dep. mn. CFSTI $4.00 cy, $1.00 mn.

Work Performed under United States-Euratom Joint Research and Development Program.

Each process in the welding of very thick steel plates was thoroughly investigated in order to find a means to prevent the occurrence of brittle fracture. The steels used were similar to ASTM A302B, but with lower C and Mo contents, which was counterbalanced by Ni and Cr additions. The properties of the steel plates were completely characterized in the normalized-tempered and quenched-tempered states. Three welding processes were investigated: manual welding with coated electrodes, automatic welding with magnetic flux, and automatic submerged arc welding; filler metals were developed for each process. The conditions for embrittlement of the filler metal and welded joint due to the simultaneous work-hardening and aging during the welding process and the optimum restoration heat treatments were also investigated. (W.L.G.)

23622 (RMI-4) QUARTERLY PROGRESS SUMMARY, OCTOBER-DECEMBER 1964. (Reactive Metals, Inc., Ashtabula, Ohio). Mar. 18, 1966. Contract AT(30-1)-1405. 86p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Billets with a $7^3/_8$ in. OD were extruded using various ram speed-billet temperature combinations to study their effect on extrudability and extrusion grain structure. Various methods of eliminating or reducing coarse ID grain structure (duplexing) associated with the Mark VE-I extrusion were investigated. Double extrusion of these fuel elements was successful toward this end but does not appear to be attractive from a cost standpoint. The heating of uranium tubing for production roll straightening by the electrical resistance method was investigated on a laboratory basis with promising results. A continuation of this investigation on a pilot production resistance heater was justified. ID grain refinement in NPR-NOE primary extrusions was accomplished by extrusion over a tipped mandrel. Improved quality of the ID cladding of the co-extruded element at HAPO is the ultimate objective. The development project aimed at the extrusion of the Mark VE-I tube with a water cooled mandrel was finalized. The practice appears to be adaptable to production processing and could be accompanied with a substantial reduction in mandrel costs. Piercing activity was changed from the Mark V-B to the Mark VE-O billet size due to the phasing out of the Mark V-B fuel element. Exploratory experiments in NPR-NOE piercing yielded some promising results. (W.L.G.)

23623 ELECTRON-BEAM WELDING OF MOLYBDENUM. P'an, Chi-luan; Wang, Chin-lun; P'ang, Mioa-laing. Ch'ing Hua Ta Hsueh Hsueh Pao, 11: No. 2, 15-35 (1964). (In Chinese).

Optimum parameters were determined for the electron-beam welding of Mo 15-mm thick. Welding was done on a stand type LD-30S of Chinese design. The effect of the degree of the vacuum and of the welding technology on the properties, particularly the ductility, of Mo welds, and the causes of their brittleness were analyzed. In the process of welding and regardless of the parameters, the local vacuum in the welding bath zone is lowered as a result of the dissociations and metallurgical reactions in the welding bath. The vacuum may be increased by introducing Ti or Ce as a getter into the weld zone. Processing the surface prior to welding affects the local vacuum, but does not increase the ductility of the weld. Prior to welding the surface may be cleaned chemically, and welding must proceed at a speed of 11.4 m/hr with a current of 100-200 ma, a voltage of 15 kv, a vacuum of 1×10^{-5} mm Hg; the temperature at which the weld reaches the brittle state is 0-100°C. The brittleness of the welds is connected with grain size and the presence of impurities at the boundaries. (CFSTI)

23624 FABRICATION OF TUNGSTEN AND TUNGSTEN-25RHENIUM TUBING. Isserow, S.; Hunt, J. G.; Jenkins, R. G.; Friedman, G. I. (Textron Inc., West Concord, Mass.). J. Spacecraft Rockets, 2: 1010-12(Nov.-Dec. 1965).

For the fabrication of seamless tubing by extrusion and drawing tungsten-25% rhenium alloy, which has both greater strength and greater ductility than pure tungsten, was used. Three basic steps are involved: primary extrusion, re-extrusion, and drawing. For W-Re development work was devoted to tubing with diameters in the range of 0.4 to 0.1 in. and wall thickness about one-tenth the diameter. Most extrusions of W and W-Re were done by the filled-billet technique at rather high temperatures. Even at the temperatures adopted to obtain substantial plastic working of the metal, deformation was difficult but was facilitated by the filler materials. With proper die design and lubrication, a solid assembly gave an extruded rod in which the ratios of the various components were maintained. The billet design for W-Re is illustrated. The extrusion temperatures were 1600 and 1200°C for W-Re and W, respectively. The extrusion procedure can be repeated using the product of a preceding extrusion as the starting material. For tungsten, satisfactory re-extrusion was achieved at 1200°C; for W-25% Re, it appeared desirable, and perhaps even essential, that the primary extrusion be subjected to a recrystallization heat treatment before being re-extruded. The drawing of W-25 Re was more successful than that of W, because of its greater ductility, but it was made more difficult by the greater strength of the material. Both W and W-Re were drawn at about 500°C. Pilot production of W-25 Re was projected in two sizes. (BBB)

23625 PREPARATION OF DENSE UO_2 PELLETS FROM POWDERED U_3O_8. Landspersky, Hanus; Bezucha, Jaromir (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jad. Energ., 12: 46-9(1966). (In Czech).

For the preparation of dense UO_2 pellets from powdered U_3O_8, a simple procedure is proposed based on pressing U_3O_8 into the shape required, followed by reduction and sintering of reduced pellets at 1450°C. Reduction, which is the most sensitive operation, takes place at 400–500°C and must be carried out in such a way that the rate of water vapor formation does not exceed the rate of diffusion of this vapor from the pellet. The procedure proposed can be applied to U_3O_8 materials of different origin. Shrinkage during reduction and sintering is the same as for the materials prepared from powdered active UO_2. (auth)

23626 MANUFACTURING A NUCLEAR REACTOR VESSEL. George, John A. (Allis-Chalmers Mfg. Co., Milwaukee). Metal Progr., 89: 56-61(Apr. 1966).

In building a 100 ton pressure vessel for a nuclear reactor, engineers employed plates and forgings of low alloy steel (ordered to the ASTM A302 Grade B and A336 specifications, respectively), clad with austenitic stainless steel. Careful welding, stress relieving, and inspection assured a pressure-tight vessel capable of operating at 650°F. (auth)

23627 WORKING WITH TANTALUM. Droegkamp, Robert E. (Kawecki Chemical Co., Boyertown, Pa.). Metal Progr., 89: 133-4; 139-42(Apr. 1966).

The heaviest, most corrosion-resistant of the refractory metals, tantalum, is easily worked by conventional machining, joining and deformation methods. Typical applications: capacitors and other electronic devices, chemical processing equipment, heating elements and surgical items. (auth)

23628 THE PLUTONIUM FUEL DEVELOPMENT LABORATORY OF THE ATOMIC FUEL CORPORATION. Nakamura, Yasuji (Atomic Fuel Corp., Tokyo). Nippon Genshiryoku Gakkaishi, 8: 41-5(1966). (In Japanese).

It is uncontestable that plutonium fuel development is essential in determining nuclear fuel policy, especially in this country which has very few uranium resources and no diffusion plant, and consequently has to import enriched uranium. Japan's plutonium development program must be pursued with the view to the use of this fuel in fast breeder reactors as well as in thermal reactors in order to economize the enriched uranium to be imported. The Plutonium Fuel Development Laboratory of the Atomic Fuel Corporation has now been completed and is embarking on work concerning plutonium handling. Some of the safety aspects of this facility are discussed in its relation to the fuel development program. Since mixed-oxide-fuel element fabrication based on vibratory compaction and sol-gel preparation of coarse and high-density UO_2-PuO_2 particles have been chosen as the main processes to be utilized, the problem of plutonium containment presents less difficulties than in the case of metal or other pyrophoric compounds. Various kinds of safety equipment are installed, including a criticality warning system and fire protection. The safety system also includes a series of operating procedure manuals and criteria, and discipline demanded of laboratory personnel is discussed in brief. (auth)

23629 PREPARATION OF RARE EARTH METAL POWDERS AND THEIR ALLOYS BY THE POWDER METALLURGY METHOD. Frankevich, D. P. Porosh. Met., Akad. Nauk Ukr. SSR, No. 2, 11-14(Feb. 1966). (In Russian).

A method was developed for the preparation of chemically active or pyrophoric metal powder by means of mechanical granulation in a liquid that does not interact with the metals or their powders. To obtain metal alloys characterized by high vapor pressure and a high evaporation rate at their melting temperature, a method was proposed excluding oxidation or evaporation of the components. It consists of sintering of pressed briquettes in glass or quartz tubes in an argon atmosphere under excessive argon pressure. (auth)

23630 DIFFUSION INTERACTION THROUGH CONTACT BETWEEN MATERIALS AND THEIR CLADDING. Babadzakhryapina, A. A. (ed.) (Inst. of Power Engineering, Obninsk, USSR). pp 153-80 of STI-PUB-109(Vol.2). (In Russian).

The diffusion interaction of materials with their cladding both during fabrication in a vacuum and during protracted isothermal heating is discussed. The results are given for diffusion in the C-Zr and C-ZrC systems. (auth)

23631 ON THE MECHANISM OF SHRINKAGE OF ZIRCONIUM DIBORIDE IN THE PROCESS OF SINTERING. Kuzenkova, M. A.; Kislyi, P. S. Porosh. Met., Akad. Nauk Ukr. SSR, No. 2, 46-55(Feb. 1966). (In Russian).

The regularities of shrinkage of zirconium diboride during sintering are described. It was established that zirconium diboride, like other brittle materials, had the same shrinkage in the direction of application of the pressing forces and in the radial direction. On the basis of the kinetic dependence of shrinkage and the changes in porosity, it is shown that with isothermal processing at times up to 30 min intense shrinkage of zirconium diboride may be described as a process of sliding along grain boundaries under the effect of surface tension forces. With isothermal processing at times over 30 min shrinkage is due to viscous flow caused by directed diffusion displacement of the atoms under the effect of the gradient of the vacancies on the pore surfaces and the grain boundaries. The presence of dodecaboride in zirconium diboride activates shrinkage in connection with the speeding up of diffusion processes on the grain boundaries. (auth)

23632 ULTRASONIC WELDING OF ALUMINUM LEADS TO TANTALUM THIN FILMS. Coucoulas, Alexander (Western Electric Engineering Center, Princeton, N. J.). Trans. Met. Soc. AIME, 236: 587-9(Apr. 1966).

Resistance-heating was used in conjunction with ultrasonic welding to produce a joint with no strain hardening nor evidence of gross substrate damage, the main causes of weld failures. The resistance heating was accomplished by passing an a-c current through the lead wire, lead-weld tip interface, weld tip, and ultrasonic horn. (W.L.G.)

23633 PROBLEMY PRASKOVEJ METALURGIE. SBORNIK VEDECKYCH PRAC. (Problems in Powder Metallurgy. Collection of Articles). Kubelik, Jaroslav (ed.). Bratislava, Vydavatel'stvo Slovenskej Akademie Vied, 1963. 94p.

Seven articles on problems encountered in powder metallurgy are compiled. The topics discussed are problems connected with the sintering of construction materials, technology and properties of metal ceramic refractory materials, surface stress in sintered copper–lead systems, sintered lead bronze and laminated layers, theory of pulverization of metals by whirling, effect of preparation variables on the particle size distribution of powdered metals, and phosphorus–alloyed sintered steel. A separate abstract was prepared for one of the papers. (J.S.R.)

23634 TECHNOLOGY AND PROPERTIES OF METAL CERAMIC REFRACTORY MATERIALS. Samsonov, G. V. (Inst. of Metal Ceramics and Special Alloys, Kiev). pp 13-29 of Problemy Praskovej Metalurgie. Sbornik Vedeckych Prac. Kubelik, Jaroslav (ed.). Bratislava, Vydavatel'stvo Slovenskej Akademie Vied, 1963. (In Czech).

The refractory compounds such as borides, carbides, nitrides and silicides, and also the carbides of nitrides of boron and silicon are materials that possess stability at high operating temperatures. The products manufactured from such materials, which can only be produced from powder metallurgy, make it possible to solve completely new problems such as the pumping and shipment of molten metals and the continuous measurement of the temperature of molten metals, steel included. Therefore, it is necessary to determine the fundamentals for the automation of metallurgical processes and for the solution of the whole series of additional problems. On this basis, it is necessary to study the technology of the preparation of these materials and to search for new areas of applicability in metallurgy. (tr-auth)

23635 PROCESS FOR SHEATHING ELEMENTS OF FISSIONABLE MATERIAL FOR NUCLEAR REACTORS. Beernaert, Claude (to Commissariat a l'Energie Atomique). German Patent 1,206,096. Dec. 2, 1965. Priority date May 11, 1959, France.

The sheath is prepared from thin sheets of metal which are formed on parallel rods by taking advantage of the plastic properties of a flexible support disposed between the sheets. It is removable after forming of the sheath and allows lateral displacement of the various rods during the forming of the sheath while at the same time preserving the respective layout of the rods. The plastic properties of the sheet metal are also utilized. (Gmelin Inst.)

23636 METHOD FOR STICKING METAL PLATES TOGETHER. Komai, Kenichiro (to Hitachi, Ltd.). Japanese Patent 1964-10692. May 29, 1965. Filed Apr. 3, 1963.

The proposed method for sticking Al plates together is simple and the resulting surface is smooth and clean. One of the two metal plates has a hole (or holes) cut through it; the other plate has a cone-shaped hole at the corresponding position, which does not penetrate through the plate. A sort of bush (or cylindrical piece), made of a light metal and having a large opening at one end, is inserted into the hole of the first metal plate and the conical hole of the second plate with the large opening facing the bottom of the conical hole; a small conical metal block is fitted into the opening. The bush is then pressed hard in the hole(s), thus sticking together the two metal plates. (TCO)

23637 URANIUM MONOCARBIDE THERMIONIC EMITTERS. Hill, Robert F.; Paprocki, Stan J.; Keller, Donald L. (to General Motors Corp.). U. S. Patent 3,232,717. Feb. 1, 1966. Filed May 14, 1962.

A method is described of fabricating an electron emitter element of UC for a thermionic device. The UC is combined with either Re, W, or an alloy of the two to form a cermet having better structural properties than the UC alone. The cermet body is provided with a Nb cladding, and a thin layer of Re or W, preferably the latter, is interposed between the cladding and the UC to prevent diffusion and reaction between the Nb and the UC during manufacture and operation of the emitter. The cermet body can contain from 10% up to 80% by volume UC, with the upper end of the range being preferable if the emitter is for use in a nuclear reactor type thermionic converter. (B.L.M.)

Properties and Structure

See also CHEMISTRY — Inorganic and Physical Chemistry
PHYSICS — Solid State Physics

Refer also to abstract 24734.

23638 (AD-624298) ELECTRON SCATTERING EXPERIMENTS; MEASUREMENT OF TRANSMISSION OF 8.3-Mev NEUTRONS PRODUCED BY A VAN DE GRAAFF GENERATOR; MAGNETIZATION CURVE OF HOLMIUM. Periodic Status Report, July 1–September 30, 1965. Little, W. A. (Stanford Univ., Calif. Dept. of Physics). Contract Nonr-225(86). 3p. CFSTI $1.00 cy, $0.50 mn.

A summary is given of research on electron scattering in holmium and neutron transmission using either the Stanford linear accelerator or a Van de Graaff accelerator. (TAB)

23639 (AD-625687) ELECTRON-NUCLEUS MAGNETIC INTERACTIONS IN Cs METAL. Holcomb, D. F.; Kaeck, J. A.; Strange, J. H. (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Dec. 1965. Contract Nonr-401(54). 17p. (TR-1). CFSTI $1.00 cy, $0.50 mn.

The characteristic nuclear magnetic resonance parameters, Knight shift, line shape and width, and relaxation times were measured in cesium metal from the melting point to 1.4°K. The nuclear spin relaxation time, S, is inversely proportional to the temperature from 300 to 7°K, with ST = 0.13 = 0.01 sec. For temperatures below 7°K, the relaxation shows another contribution. The Knight shift increases linearly with temperature down to 4°K, following the line previously measured by Gutowsky and McGarvey at higher temperatures. Diffusion narrowing of the magnetic resonance line is observed at 190°K, but the strong electron-nuclear interactions preclude good diffusion constant measurements. (TAB)

23640 (ANL-7176, pp 45-72) GENERAL REACTOR TECHNOLOGY. (Argonne National Lab., Ill.).

Experimental reactor and nuclear physics research during this period is briefly outlined. Various high-temperature studies were made on ceramics and liquid-metal corrosion. Nondestructive tests were made on several reactor structural materials. Research on fluidization and volatility separations processes is discussed. (M.O.W.)

23641 (AROD-4074:2) INFLUENCE OF INTERSTITIAL IMPURITIES ON THE LOW-TEMPERATURE STRENGTH AND DUCTILITY OF BODY-CENTERED CUBIC METALS. Final Report. Stein, D. F.; Low, J. R. Jr. (General Electric Co., Schenectady, N. Y.). Mar. 1966. Contract DA-31-124-ARO(D)-95. 25p.

A new technique for removing interstitial impurities from bcc metals was devised in which a very high purity atmosphere of hydrogen was maintained over samples being heated at high temperature. For iron, this technique was shown to reduce the carbon to less than 0.005 ppM, nitrogen to less than 2 ppM, and oxygen as low as 3 ppM. The level of oxygen also depended upon the oxygen concentration in the starting material. The high-purity hydrogen purification technique was combined with other techniques such as zone melting, and high-purity arc melting to produce iron, molybdenum, and tungsten of high purity with respect to interstitial impurities. The effects of interstitial impurities on the mechanical properties of these metals were examined. (auth)

23642 (BAW-267) ETCHANT DEVELOPMENT FOR THORIA FUELS. Quarterly Progress Report, November 1, 1964. Halva, C. J.; Dodd, R. H.; Dewell, E. H. (Babcock and Wilcox Co., Lynchburg, Va.). 26p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Samples of sol-gel ThO_2-UO_2 were heated at 2000°C to obtain material with a large grain size to serve as a testing matrix for a series of etchants. Comparison tests were made on ThO_2-UO_2 prepared by more conventional coprecipitation methods. The samples were treated for 35 sec at 150°C in a 30:1 H_3PO_4-HF mixture. Photographs showing the progress of grain development are presented. (W.L.G.)

23643 (BM-RI-6771) CONSOLIDATION AND MECHANICAL PROPERTIES OF ELECTROWON MOLYBDENUM. Loria, Edward A.; Kees, J. M. (Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center). Apr. 1965. 21p. Bureau of Mines Free.

High-quality sheet of electrowon molybdenum was attained by a sequence of procedure on pressed and arc-melted crystalline powders. The procedures included high-temperature, high-vacuum sintering treatments and the use of metal deoxidizers instead of carbon to improve the mechanical properties of the molybdenum sheet. Rolled sheet 60 mils thick was evaluated by tensile and bend tests, hardness measurements, microstructures, and recrystallization treatments. After stress relieving, yield strength ranged from 85,000 to 110,500 psi (0.2% offset) and ultimate strength ranged from 87,200 to 117,250 psi with 4.5 to 25% elongation observed for arc-melted sheet, and 5.0 to 23% elongation observed for powder metallurgy sheet. In room temperature bend tests the sheet yielded plastically, indicating that the ductile-brittle transition point was below room temperature. The diamond pyramid hardness (DPH) of the molybdenum sheet changed from 214 to 293 DPH for the stress-relieved condition to 177 to 185 DPH for the fully recrystallized condition. The brittleness of recrystallized molybdenum, reported by other investigators as characteristic of sheet prepared from commercial-grade hydrogen-reduced powders, was not in evidence. Recrystallized tensile specimens pulled at room temperature had an average elongation of 31%. (auth)

23644 (BNL-10132) PLATINUM FOR HIGH TEMPERATURE CRUCIBLES USED IN PROCESSING RADIOACTIVE WASTE. Weth, G. G.; Strickland, G.; Tuthill, E. J. (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT-30-2-GEN-16. 14p. (CONF-660208-17). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Symposium on Solidification and Long-Term Storage of Highly Radioactive Wastes, Richland, Wash.

In the development of the phosphate glass process for conversion of highly radioactive wastes to stable solids, platinum was used successfully for the high temperature crucible. In this application a platinum crucible was used at temperatures of 800–1200°C for a total of 8000 hours with no signs of deterioration. It was demonstrated that chemical reducing conditions must be avoided; otherwise rapid deterioration of platinum may take place in the presence of molten phosphate. Tests to determine the useful life of platinum included long-term creep measurements at 1250°C. The latest results of these tests, which are still in progress, are presented. Economic factors associated with the use of platinum in high level waste processing are discussed briefly. (auth)

23645 (CEA-R-2854) CHALEUR SPECIFIQUE ELECTRONIQUE DE CARBURES DE METAUX DE TRANSITION [THESES]. (Electronic Specific Heat of Transition Metal Carbides [Thesis]). Conte, Rolland (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1965. 59p. Dep. mn.

Submitted to Paris Univ., France.

The electronic specific heats of transitional metal carbides of varying electronic concentration (TiC, either stoichiometric or non-stoichiometric, TaC, and mixed (Ti, Ta)–C) were measured. The low temperature specific heat apparatus used is described. In one of these helium is used as the exchange gas; the other is set up with a mechanical contact. The two use a germanium probe for thermometer. Measurement of the temperature using this probe is described, as well as the various measurement devices. The results are presented in the form of a rigid band model and show that the density of the states at the Fermi level has a minimum in the neighborhood of the group IV carbides. (P.C.H.)

23646 (CEA-R-2961) MESURE DE LA PRESSION DE DISSOCIATION DU MONOCARBURE D'URANIUM ENTRE 2250 ET 2500 deg K PAR LA METHODE D'EFFUSION DE KNUDSEN. (Measurement of the Dissociation Pressure of Uranium Monocarbide Between 2250 and 2500 deg K by the Knudsen Effusion Method). Anselin, Francois; Poitreau, Jean (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan. 1966. 28p. Dep. mn.

Decomposition pressures of monocarbide samples and uranium carbon alloys of composition UC, were measured by the Knudsen effusion method. Samples were heated under vacuum in a tungsten effusion-cell by electronic bombardment and known fractions of the vapor were condensed on cooled targets. The determination of uranium content deposited on target was performed by chemical analysis, alpha counting, and recording and counting tracks of fission fragments of uranium in mica after irradiation of the targets in the reactor EL II at Saclay. The three techniques gave the same results. The decomposition pressure of UC with C/U = 0.983 expressed in atmosphere of uranium is given by: $\log p\,(Ug)_{atm} = (2.570/T), 10^4 + 4.785$ in the temperature range from 2250 to 2500°K. The too low pressures measured under 2200°K and the instantaneous formation of a eutectic W–UC at about 2520°K limit the temperature range investigated. At constant temperature, a continuous pressure increase versus heating time was observed with $UC_{1.10}$ until a limit value was reached. This limit pressure was the same as measured with $UC_{1.00}$ under the same conditions at the same temperature. The pressure increase is related to a reaction between the tungsten in the cell and uranium carbide. The extrapolation at zero time of isotherms log p–versus time gave an estimation of dissociation pressure of $UC_{1.10}$ expressed in atmosphere of uranium: $\log p\,(Ug)_{atm} = -(2.60/T), 10^4 + 4.41$. Uranium decomposition pressures for both $UC_{1.00}$ and $UC_{1.10}$ were extremely low, and vaporization of carbide is congruent for a composition close to $UC_{1.10}$ in agreement with previous results. In contradiction with general agreement, tungsten is not compatible with uranium–carbon alloys at any composition. (auth)

23647 (N-65-11409) EFFECT OF ORIENTATION ON THE BEND FATIGUE BEHAVIOR OF BERYLLIUM. Quarterly Progress Report, July 22–October 21, 1964. Lawley, A. (Franklin Inst., Philadelphia, Pa. Labs. for Research and Development). Nov. 5, 1964. Contract NASr-145. 8p. (NASA-CF-59563; Q-B2028-8). CFSTI $1.00 cy, $0.50 mn.

The specific differences between the slip surface structure and the underlying dislocation substructure are being investigated in bend-fatigue beryllium crystals oriented for either basal or prism slip. The basal bend-fatigue crystal shows a uniform and relatively fine slip structure extending over the entire central gage section. Closer to either grip, deeper slip steps occur, indicating stress concentrations at these locations. No persistent slip structures are seen below a depth of ~1μ from the original surface. The surface slip structure on prism bend-fatigue crystals is characterized by slip on both the prism and basal planes, and by the presence of a distinct brownish discoloration whose intensity increases with increasing number of cycles. The discoloration is confined to the upper and lower bend surface, through which the edge dislocations having the $\frac{1}{3}$ [2110] Burger's vector emerge. The duplex slip structure is accompanied by fissures running across the bend surface in the [0002] direction, corresponding to the intersection of the prism plane with the bend surface. Persistent slip bands to a depth of at least 5μ were observed. Specially prepared micrographs indicate that in all cases the persistent slip bands on both the prism and basal planes correspond to intrusions. (STAR)

23648 (N66-11248) RESEARCH ON A SUPERCONDUCTING NIOBIUM–THORIUM EUTECTIC ALLOY AND SUPERCONDUCTING COMPOSITES. Cline, H. E.; Strauss, B. P.; Rose, R. M.; Wulff, J. (Massachusetts Inst. of Tech., Cambridge). [1965]. Contract NAS3-2590. 66p. (NASA-CR-54663).

Various Cu/Nb composites were fabricated in order to understand the behavior of the Nb–Th alloy. Three major results have come of this: a direct measurement of the proximity effect in a multiple structure, some predictions regarding the feasibility of type II composites, and fabrication procedures which result in uniform deformation. The latter were used to make preliminary Nb_3Sn composites of high promise, for flexible material of low cost, and superior mechanical and superconducting properties. (auth)

23649 (NAA-SR-Memo-6532) PROPERTIES OF SNAP 4 MATERIALS. Watrous, J. D. (Atomics International, Canoga Park, Calif.). June 26, 1961. Contract AT(11-1)-Gen-8. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Pertinent physical and mechanical properties of Zr and Zr–U hydrides have been abstracted from recent publications from General Electric-Aircraft Nuclear Propulsion Department, Denver Research Institute, Battelle Memorial Institute, General Atomics, National Bureau of Standards, and Atomics International. Similar data on stainless steels were obtained from the Metals Handbook, 8th Edition. This information is presented in graphical and tabular form for ready use. (auth)

23650 (NAA-SR-Memo-6957) TENSILE PROPERTIES OF SNAP 4 FUEL MATERIAL AT ELEVATED TEMPERATURES. Lundberg, L. B. (Atomics International, Canoga Park, Calif.). Jan. 3, 1962. Contract AT(11-1)-Gen-8. 12p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

SNAP 4 fuel material (Zr–8 wt.% U, H/Zr = .8 – 1.2) was tensile tested in a helium atmosphere at 700, 800, and 1000°F. The ultimate tensile strengths determined at the three test temperatures were 16,600, 14,400, and

20,900 psi, respectively. The only 0.2% offset yield strength observed was 12,800 psi at 1000°F. Brittle fracture with no yield point took place at the other two test temperatures. Young's modulus was calculated from the straight line portion of the stress-strain curve, and the values were determined to be 10.6×10^6 psi at 700°F, 10.7×10^6 psi at 800°F, and 8.6×10^6 psi at 1000°F. (auth)

23651 (NASA-CR-458) COMPUTATIONAL METHODS FOR CALCULATION OF RATES OF EVAPORATION IN THE Ta–Hf–C SYSTEM. Kaufman, Larry; Stepakoff, Gerald (Manlabs, Inc., Cambridge, Mass.). Apr. 1966. Contract NAS-3-4910. 43p. CFSTI $2.00 cy, $0.50 mn.

The Schottky-Wagner model was applied to the Ta–Hf–C system in order to generate equations capable of predicting the vapor pressures of the elemental components and the rates of Langmuir evaporation for a wide range of compositions and temperatures. The numerical evaluation of the vapor pressure and rate of evaporation of each component at 2200, 2600, 2800, and 3000°K and at C levels of 41, 46, 49, and 50% is given. The computed rates of vaporization represent initial or instantaneous rates corresponding to a fixed composition. (W.L.G.)

23652 (ORNL-3510) THERMAL CONDUCTIVITY OF MAGNESIA, ALUMINA, AND ZIRCONIA POWDERS IN AIR AT ATMOSPHERIC PRESSURE FROM 200 DEG F TO 1500 DEG F [Thesis]. Godbee, H. W. (Oak Ridge National Lab., Tenn.). Apr. 1966. Contract W-7405-eng-26. 203p. Dep. mn. CFSTI $6.00 cy, $1.25 mn.

The effective thermal conductivities of magnesia, alumina, and zirconia powders in air at atmospheric pressure from 200 to 1500°F were measured by steady-state and unsteady-state methods. The effective thermal conductivity of a specific powder increased with increasing volume fraction solid until, at values close to the maximum obtainable with the power, the effective thermal conductivity was critically dependent on volume fraction. The influence of gas conductivity was greater than that of the solid on the effective thermal conductivity of powders. The effective thermal conductivity for each powder measured increased at a decreasing rate with increasing temperature, following an approximately quadratic temperature dependence. The effective thermal conductivities of two magnesia powders having different particle-size distributions and points of truncation, but almost the same shape factor, were essentially the same at the same volume fraction solid. The effective thermal conductivity of a magnesia powder was slightly higher than that of an alumina powder with almost the same shape factor and at the same volume fraction solid. The presence of a sorbed water film increased the effective thermal conductivity of each powder up to temperatures corresponding to the decomposition temperature of the respective hydroxides. Mechanical pressure on the particles caused by shrinkage of the sample container upon cooling from high temperatures increased the effective thermal conductivity by factors up to about two. All the data on effective thermal conductivity for the powders studied can be correlated well by means of a derived equation that relates effective thermal conductivity to the conductivities and concentrations of the constituent phases as well as to a shape factor. By theoretical analysis, radiation was determined not to be an important heat transfer mechanism in these powders because of low temperature and small interparticle distances. (W.L.G.)

23653 (ORNL-P-1252) CORRELATION OF COMPOSITION WITH THE MICROSTRUCTURES OF ARC-CAST THORIUM CARBIDES. Bradley, Mildred J.; Kegley, T. M. Jr. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 28p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Arc-cast thorium carbide specimens with total-C/Th atom ratios varying from 0.8 to 2.1 (4 to 10 wt.% carbon) were prepared for metallographic examination, and the microstructures correlated with the chemical analyses, the x-ray diffraction analyses, and the hydrolysis products. The thorium monocarbide phase was found over a range of composition from about $ThC_{0.94}$ (4.6% C) to at least $ThC_{0.81}$ (4.0% C) and probably lower. The maximum combined-C/Th atom ratio obtained by arc-melting with graphite electrodes was 1.95 (9.2% C) rather than the theoretical 2.00 (9.4% C). Specimens with compositions from $ThC_{0.99}$ to $ThC_{1.88}$ (4.9 to 8.9% C) were two-phase mixtures of the mono- and dicarbides. There was no evidence for any significant range of composition for the dicarbide. A new metallographic procedure contributed significantly to the study. A solution of equal parts of nitric acid (70%) and water was used to passivate and etch thorium dicarbide and two-phase thorium dicarbide-monocarbide specimens. Advantages of this technique over air etching are: (1) clearer microstructures; (2) specimens can be observed directly in air (no protective oil film is necessary); and (3) specimens can be examined more deliberately than air-etched specimens which continue to react rapidly with moisture even under an oil film. Single-phase thorium monocarbide specimens were prepared for metallographic examination by an attack-polished procedure, using dilute nitric acid and 0.3 μ alumina, followed by etching in a solution of 50 parts 70% HNO_3, 50 parts water, and 2 parts concentrated HCl. (auth)

23654 (ORNL-TM-1435) SOME ELECTRICAL MEASUREMENTS ON ANODIC FILMS ON ZIRCONIUM. Nicely, V. A.; Davis, R. J. (Oak Ridge National Lab., Tenn.). Dec. 28, 1965. Contract W-7405-eng-26. 28p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Two sets of experiments were performed in an investigation to find techniques to determine characteristics of oxide films on Zr which might, in turn, be related to corrosion mechanisms. An attempt was made to show the existence of a conductivity gradient in heated ZrO_2 film by a technique reported for films on Ta. This technique depends on the resistance and reactance of the film being of similar magnitude near the metal interface and requires that the conductivity of the oxide be greater than about $10^{-8}\ \Omega^{-1}\ cm^{-1}$. The a-c resistance data indicated that heating the oxide for short periods resulted in an increase in average conductivity of less than one order of magnitude. But the final conductivity was not high enough for a conductivity gradient to be demonstrated. Using various parameters from the literature it was indicated that longer heating times would probably result in the effect described but would also result in partial dissolution of the oxide. In another set of experiments, attempts were made to measure d-c resistance of anodic films on Zr using various contacts to the oxide interface. Contacts with Hg, evaporated Ag, and Ga were used. Two techniques with Ga were employed: Dipping a fresh surface into a pool of Ga and dipping a surface prepared by rubbing Ga onto the surface with a paper tissue. A-c impedances were measured using contacts of evaporated Ag, Ga, rubbed Ga and 1 M NH_4NO_3 electrolyte. The apparent d-c resistances measured with Ag, Hg, or unrubbed Ga contacts drifted to higher values with time and these contacts and techniques were therefore considered not useful. The rubbed Ga contacts gave currents that did not drift. The calculated resistances obeyed ohms law and increased about linearly with film thickness. A-c impedances with the same contacts gave the frequency dependence expected from a capacitance (Cp) in parallel with resistance (Rp). The values of Rp agreed with the d-c resistances. However, resistances were much less than those exhibited by other types of contacts. Two different models are suggested: The Ga is rubbed into tiny pores, which provide a resistance parallel to the film capacitance. The film is made up of two layers; a thin, outer, high resistance layer that is penetrated by the rubbing with Ga and an inner, bulk layer which has a lower resistivity, probably due to electrons associated with anion vacancies. The rubbed Ga contact is apparently not useful for direct determination of the resistance of the complete film, but may be helpful in studying mechanisms, for instance, further study might provide proof or disproof of pores. (auth)

23655 (RFP–643) LOW-ENERGY ELECTRON DIFFRACTION STUDY OF THE (100) PLANE OF A TUNGSTEN SINGLE CRYSTAL. Adams, R. O. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). Apr. 4, 1966. Contract AT(29-1)-1106. 48p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

A survey of the low-energy electron diffraction technique is given. Diffraction patterns associated with a clean tungsten (100) surface are given and analyzed. It is found that subsurface layers contribute significantly to the diffraction pattern obtained from this plane even at low electron energies. Chemisorption of nitrogen, oxygen, hydrogen and carbon monoxide are followed by observation of changes in the diffraction pattern. No rearrangement of the tungsten surface due to the chemisorbed gases is observed. (auth)

23656 (TRG-Report-1151) INTERNAL FRICTION IN NIOBIUM-OXYGEN SOLID SOLUTION. Szkopiak, Z. C. (Battersea Coll. of Technology, London (England). Dept. of Metallurgy and Materials Technology). June 1965. 10p. Dep. BIS $0.30. HMSO 1s. 9d.

A relationship was established between the height of the internal friction relaxation peak for oxygen in niobium and the amount of oxygen present in niobium of commercial purity and in electron beam refined material. The relationship takes the form $C_0 = K\,\delta_{max}$, where C_0 is the oxygen content (wt. %), δ_{max} is the logarithmic decrement corresponding to the relaxation peak and K is a parameter whose value varies with the distortion of the niobium lattice caused by substitutional impurities. Analysis of the latter effect indicated that it could be used for calculating the effective diameters of interstitial atoms in solid solution with bcc metals. (auth)

23657 (UCRL–14759) STATISTICS AND COMPUTERS IN MINERALOGY, MATERIALS RESEARCH AND SEDIMENTARY PETROGRAPHY. Kahn, J. S. (Lawrence Radiation Lab., Univ. of California, Livermore). Mar. 10, 1966. Contract W-7405-eng-48. 17p. (CONF-660410–1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From 6th Annual Symposium on Computers and Operations Research in Mineral Industries, University Park, Penn.

The resolution of three different problems, in which the computer and statistics played a significant role as tools, is discussed. The first two problems are concerned with obtaining estimates of regression coefficients. In the first study, which is a straightforward application of the estimation of linear parameters by the method of least squares, these estimates were used to generate a prediction curve for the strength of polycrystalline BeO. The second problem relates the indexes of refraction of single crystals of synthetic BeO to the different wavelengths at which the indices were measured. This is done by fitting the experimental data to a Sellmeier equation. Here least-squares estimation is performed with nonlinear parameters. Finally, the last problem is concerned with the analysis of dimensional or crystallographic orientation data. Here standard procedures of statistical estimation and hypothesis testing are used with the computer acting mostly as a modest decision maker and information storer. (auth)

23658 (WCAP–3269-42A) BIAXIAL STRAIN FATIGUE OF ZIRCALOY-4. PART A. EXPERIMENTAL AND ANALYTICAL TECHNIQUES. Schreiber, R. E. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Oct. 1965. Contract AT(30-1)-3269. 70p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The testing procedures that were used in the study of strain fatigue in biaxially stressed Zircaloy-4 at 715°F are described. (auth)

23659 (WCAP–3269-42B) BIAXIAL STRAIN FATIGUE OF ZIRCALOY-4. PART B. ANALYSIS OF TEST RESULTS, DEVELOPMENT OF STRAIN FATIGUE MODEL, AND APPLICATION TO DESIGN. Schreiber, R. E. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Oct. 1965. Contract AT(30-1)-3269. 136p. Dep. mn. CFSTI $4.00 cy, $1.00 mn.

Biaxial strain fatigue data are reported for 10–15% cold worked Zircaloy-4 tested at 715°F. Push-pull cyclic buckling tests were also performed. A mathematical model of strain fatigue was developed and applied to a design problem involving fuel rod cladding for the San Onofre Reactor. The predicted fraction of fatigue life consumed was 30%. (auth)

23660 (WERL–1114-2) STRESS DISTRIBUTION IN A PRESSURIZED CYLINDER WITH EXTERNAL LONGITUDINAL NOTCHES. Leven, M. M. (Westinghouse Research Labs., Pittsburgh, Pa.). Aug. 1965. Contract AT(11-1)-Gen-14. 41p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A cylindrical vessel with four external longitudinal notches was subjected to internal pressure. The results of a photoelastic analysis of the principal stresses along the section of symmetry of six transverse sections through the shortest and most shallow notch are presented. The maximum stresses at the tip of the notch were found to be 20.0 times the nominal stress S in the circumferential direction and 7.1 S in the longitudinal direction. A maximum radial stress of about 3.0 S was developed at a distance of 1.7 times the radius from the notch tip. The stress field parameter for brittle fracture was found to vary from 0.73 to 0.97 as calculated by various methods. (auth)

23661 (WERL–8844-11) INVESTIGATION OF THE APPLICABILITY OF THE BIAXIAL BRITTLE FRACTURE TEST FOR DETERMINING FRACTURE TOUGHNESS. Final Summary Report. Wessel, E. T.; Pryle, W. H. (Westinghouse Research Labs., Pittsburgh, Pa.). Aug. 1965. Contract NObs 78844. 29p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

For Bettis Atomic Power Lab., Pittsburgh, Pa.

The biaxial brittle fracture specimens, now designated as the wedge-opening-loading (WOL) specimens, was found to be applicable for plane-strain fracture toughness measurements (K_{IC}) in 3 lots of A302B steel. Three specimen sizes, 1, 2, and 4 in. thick, were tested over a range of temperatures from −320 to 200°F. The temperature range in which valid K_{IC} data is obtained is dependent upon the material and the specimen size. The results indicate that larger specimens (>4 in. thick) will be required to obtain valid data at ambient temperatures in typical materials. The investigation contributed substantially to advancing the state-of-the-art, and the WOL specimen has demonstrated considerable potential for fracture toughness testing of these low-strength, moderate-toughness materials. (auth)

23662 (LA-tr–66-21) DIFFUSION OF CARBON IN NIOBIUM AND TITANIUM CARBIDE. Shcherbedinskaya, A. V.; Minkevich, A. N. Translated by Helen J. Dahlby (Los Alamos Scientific Lab., Univ. of California, N. Mex.), from Izv. Vyssh. Ucheb. Zaved. Tsvetn. Met., 8: No. 4, 123-5(1965). 6p. Dep. mn. CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf.

The diffusion coefficients for C in NbC at 1100 to 1500°C and in TiC at 900 to 1200°C were determined. The activation energy for diffusion of C in TiC was higher than that for C in NbC. (W.L.G.)

23663 PRECIPITATION AND OXIDATION STUDIES IN THE Cu–Fe SYSTEM USING THE MOESSBAUER EFFECT. Gonser, U.; Grant, R. W.; Muir, A. H. Jr.; Wiedersich, H. (North American Aviation, Inc., Thousand Oaks, Calif.). Acta Met., 14: 259-64(Mar. 1966).

The following processes in Cu–Fe alloys were studied by Mössbauer effect spectroscopy: precipitation of γ-Fe from Fe in solution in Cu, transformation of γ-Fe to α-Fe by plastic deformation; internal oxidation of γ-Fe to FeO, oxidation of FeO to Fe_3O_4; and hydrogen reduction of FeO to Fe. The atomic nature of this method permits a unique identification of phases in multiphase regions of this system. At liquid nitrogen temperature, the unsplit lines of γ-Fe and Fe in solution are shifted $-0.06_4 \pm 0.02$ and $+ 0.27_4 \pm 0.02$ mm/sec, respectively, relative to the center of the six line bcc α-Fe spectrum. The Mössbauer method was also used to study the electronic transition of Fe_3O_4 known to occur at ~120°K. For the sample investigated ($Fe_{2.98}O_4$)

the transition occurred over a ~6°K temperature range centered at 119°K. (auth)

23664 PLASTIC DEFORMATION PRECEDING FRACTURE IN TUNGSTEN CARBIDE–COBALT ALLOYS. Bartolucci, Silvana; Schloessin, H. H. (Univ. of Witwatersrand, Johannesburg). Acta Met., 14: 337-9(Mar. 1966).

Fractographic studies by electron microscopy were carried out on WC–Co alloys subjected to bending, indentation, and sliding friction of a micro-indenter. Examples were found of intracrystalline fracture originating from slip line intersections, of transgranular fracture emanating from intergranular fracture after deformation by slip, and of slip transfer from one region to another. (auth)

23665 ANNEALING TWINS AND TWIN-BOUNDARY INTERSECTIONS IN NIOBIUM. Wasilewski, R. J. (E. I. du Pont de Nemours and Co., Wilmington, Del.). Acta Met., 14: 433-6(Mar. 1966).

Arc-melted niobium buttons were machined and subjected to a plane-wave, 250-kbar explosive shock at room temperature to form a significant density of twins. The incidence of annealing twins, as determined by the criterion described, was low. Only eight pairs of such grains were formed in two $\frac{1}{4} \times \frac{1}{2}$ in. specimens. This observation confirms indirectly the high stacking-fault energy as Nb as compared with that in many fcc metals. The formation of non-crystallographic twin boundaries and their annihilation by subsequently formed mechanical twins indicate that ordered arrays of stacking faults can form on planes other than (112) without significant additional energy. It implies also that coherent twin boundaries are not necessarily limited to either (112) or (110) co-zonal with the twinning shear direction. In view of the high mechanical twin density, a large variety of twin-twin boundary intersections was observed. (P.C.H.)

23666 TRANSMISSION ELECTRON MICROSCOPE STRUCTURE OF A Ti–9 WT. PERCENT Ta ALLOY QUENCHED FROM β REGION. Yamane, T.; Ueda, J. (Hitachi Shipbuilding and Engineering Co. Ltd., Osaka). Acta Met., 14: 438-9(Mar. 1966).

In Ti–9% Ta alloy quenched from β region, the needle-like martensitic structure was observed by an optical microscope, and a number of banded lines with dislocations were witnessed through a transmission electron microscope. One of the bands was analyzed and was found to be a $(10\bar{1}1)$ twin boundary which was, hitherto, discovered only in quenched pure Ti and had not been found in Ti alloys. (P.C.H.)

23667 THE DEFORMATION BEHAVIOR OF HIGH-PURITY POLYCRYSTALLINE IRON AND SINGLE CRYSTAL MOLYBDENUM AS A FUNCTION OF STRAIN RATE AT 300 DEG K. Davidson, D. L.; Lindholm, U. S.; Yeakley, L. M. (Southwest Research Inst., San Antonio). Acta Met., 14: 703-10(June 1966).

The mechanical behavior of polycrystalline, high-purity iron and single-crystal, high-purity molybdenum was investigated in compression over the strain rate range 10^{-4} sec^{-1} to 10^{+3} sec^{-1}. Both iron and molybdenum behaved much differently from fcc metals tested over the same range of strain rates, and the behavior of iron was considerably different from that of molybdenum. The results for iron were found to be better described by the equations of thermal activation than by equations based on the Johnson–Gilman stress-velocity relation. The equivalence of temperature and strain rate was examined and found to hold only over a limited range. In both metals, dislocation structure was found to be a function of strain rate as well as strain. (auth)

23668 STRAIN AMPLITUDE DEPENDENT INTERNAL FRICTION IN BERYLLIUM. Abrams, E. H.; Kamber, K. T.; Ang, C. Y. (Autonetics Div., North American Aviation, Inc., Anaheim, Calif.). Acta Met., 14: 729-40 (June 1966).

An investigation of the low frequency internal friction of polycrystalline beryllium revealed a significant strain amplitude dependency. Measurements between –166 and 721°C at 1 c/s in both high purity and commercial grade beryllium showed that amplitude dependent internal friction varies greatly as a function of temperature and purity. In the high strain amplitude region, amplitude dependent internal friction exhibited the same type of damping that was previously proposed as being associated with dislocation hysteresis. Activation energies were obtained that suggest that, at the lower temperatures, damping is governed by a dislocation-impurity atmosphere interaction effect, while at higher temperatures a diffusion controlled process predominates. Other observations noted in beryllium were the effects of small and large amounts of strain and deformation on the recovery and rate of recovery of internal friction in high purity beryllium. Thus, good evidence was obtained for the dislocation origin of amplitude dependent internal friction in beryllium. (auth)

23669 DEVELOPMENT OF A WROUGHT HIGH-STRENGTH MAGNESIUM–YTTRIUM ALLOY. London, R. V.; Edelman, R. E.; Marcus, H. (Frankford Arsenal, Philadelphia). Amer. Soc. Metals, Trans. Quart., 59: 250-61(June 1966).

Studies were made on the aging behavior and the mechanical properties of three magnesium–yttrium binary alloys: Mg–8.2% Y, Mg–9.0% Y, and Mg–10.6% Y. The alloys were aged in three conditions: as-rolled; solution treated; and solution treated and cold worked. The highest strengths were observed on aged, as-rolled specimens. A yield strength of 55,000 psi was obtained on the Mg–10.6% Y alloy after aging in the as-rolled condition for four days at 200°C. Higher aging temperatures and lower yttrium contents produced somewhat lower properties. The lowest strength levels were obtained on aged, solution treated specimens. Five per cent cold work, however, was sufficient to produce properties approaching the rolled and aged condition. The compressive yield strength, measured on sheet specimens, was substantially higher than that reported for any other magnesium alloy. (auth)

23670 SYSTEM SrO–ZrO_2. Cocco, Antonio; Chiacigh, Irene (Univ., Trieste, Italy). Ann. Chim. (Rome), 55: 1341-9(Dec. 1965). (In Italian).

Mixtures of $SrCO_3$ and ZrO_2 were heated 250 hours at 1300°C, cooled, reground, and then heated again at 1500°C for 500 hours; they were then heated for various times at the temperatures at which it was desired to examine the phase relations. The existence of the phase $SrZrO_3$ was confirmed, but the existence of the compound Sr_2ZrO_4 could not be confirmed. A new compound of the formula $Sr_3Zr_2O_7$ with a probable orthorhombic structure was obtained; the mechanism of formation of this compound from SrO and ZrO_2 involves the intermediacy of $SrZrO_3$. Combination of this latter compound with SrO is the slow step in the formation of $Sr_3Zr_2O_7$. At room temperature $Sr_3Zr_2O_7$ is decomposed by atmospheric moisture to yield $SrZrO_3$ and another easily hydrated phase which is probably SrO. Equilibria exists between ZrO_2 and $SrZrO_3$, between $SrZrO_3$ and $Sr_3Zr_2O_7$, and between $Sr_3Zr_2O_7$ and SrO. A probable phase diagram for temperatures above 1400°C is illustrated. Analysis was performed by the static method through a microscope using reflected light and x-rays. Several of the photomicrographs are illustrated. (BBB)

23671 STUDIES ON THE SYSTEM ZrO_2–TiO_2–$SrTiO_3$. Cocco, Antonio; Chiacigh, Irene (Univ., Trieste, Italy). Ann. Chim. (Rome), 55: 1350-6(Dec. 1965). (In Italian).

Solid-state relations between the phases in the system ZrO_2–TiO_2–$SrTiO_3$ were determined by studying the 1300°C isothermal section by the static method through a microscope using reflected light and x rays. No intermediate compounds or ternary solubility areas were observed. The phases in solid solution equilibrium are as follows: TiO_2–$SrTiO_3$, $ZrTiO_4$–$SrTiO_3$, ZrO_2–$SrTiO_3$, TiO_2–$ZrTiO_4$–$SrTiO_3$, and $ZrTiO_4$–ZrO_2–$SrTiO_3$. Tables of samples used, illustrations of photomicrographs, and the phase diagram at 1300°C are given. Distinction between phases was also achieved by attack with 20% HF, which particularly attacks the edges of granules of $SrTiO_3$; this method is particularly useful for determination of small amounts of one phase in the presence of another, and was used to demonstrate the low mutual solubility between $SrTiO_3$ and $ZrTiO_4$. (BBB)

23672 MEASUREMENTS OF STRESS RELAXATION IN POLYCRYSTALLINE MOLYBDENUM AT 90 DEG AND 298 DEG K. Kubat, Josef; Pattyranie, Carel (Royal Inst. of Tech., Stockholm). Ark. Fys., 28: 365-72(1965).

For polycrystalline molybdenum with a fiber texture the slope F of the inflection region of the stress-ln time curves and the total stress dissipation $\Delta\sigma$ are related as follows: $F \approx 0.1\ \Delta\sigma$. The decrease in the constant of proportionality on changing the temperature of measurement from 298 to 90°K is only 7%. Values in the vicinity of 0.1 have earlier been observed on a number of polymers and metals. (auth)

23673 FACTOR OF INFLUENCE OF DEFECT CONCENTRATION CHANGE ON PROPERTY CHANGE. Stevanovic, Momcilo. Bull. Boris Kidrich Inst. Nucl. Sci., 16: 193-200(Oct. 1965).

The correlation between structure defects and the corresponding property changes of material is discussed. Analysis of the occurrence of defects in structure showed that, except for the properties that are independent of the lattice energy, this correlation is not linear. A term was defined, the factor of influence of defect concentration change on property change, i.e., the influence factor, f, which determines the correlation between property change and defect concentration. It represents the differential property change over the differential defect concentration. In case the interaction of defects is represented by the differential equation $-(dc/dt) = k\ t^n$ the influence factor of the property of the irradiated material at isothermal annealing is determined. In this case f cannot be constant. (auth)

23674 CONTRIBUTION TO THE STUDY OF THE UO_2–V_2O_5 SYSTEM. Manojlovic, Ljubica; Herak, Rajna M.; Zorcic-Knezevic, Gordana M. Bull. Boris Kidrich Inst. Nucl. Sci., 16: 201-5(Oct. 1965).

The interaction of uranium dioxide and vanadium pentoxide was studied by x-ray diffraction. It was found that in pressed mixtures of the two oxides with 5% V_2O_5, heated at 900 to 1200°C in argon, a compound of the composition UV_2O_6 was formed. (auth)

23675 SPIRAL GROWTH IN PYROLYTIC CARBON. Fitzer, E.; Schlesinger, H. (Technische Hochschule, Karlsruhe, Ger.). Carbon, 3: 247-55(Dec. 1965). (In German).

Spiral growth was observed in deposits of pyrolytic carbon produced by thermal decomposition of methane in the temperature range from 1400 to 1700°C. The growth spirals are multiple spirals with diameters of about 5 to 40 μ and a height of a single step of about 1000 Å. Spiral growth was observed by optical and electronmicroscopic techniques. The spiral structure was also observed in the cross sections of the deposits; the cones of the pyrolytic carbon were formed by a multiple spiral. An explanation is given of the growth mechanism of the multiple spirals by considering a group of emergence points lying on one line and all with the same growth direction. The different densities of the spirally and the normally grown pyrolytic carbon deposits is discussed from the kinetic point of view. (auth)

23676 EFFECT OF SPECIMEN GEOMETRY ON THE TENSILE STRENGTH OF GRAPHITE. Jackson, J. L.; Freed, M. E. (Battelle Memorial Inst., Richland, Wash.). Carbon, 3: 257-9(Dec. 1965). (BNWL-SA-55).

The effects of specimen geometry on the tensile strengths of two nuclear graphites using seven different tensile specimen shapes were investigated. The design of some samples gave rise to stress concentrations where the fillet met the gage section. Evidence was obtained that geometry effects can reduce the apparent tensile strength of graphite by as much as 34%. The most satisfactory designs, determined by reference to the strength, were the streamline fillet and the straight, cylindrical sample. A method of fastening the straight, cylindrical samples to a steel grip using an epoxy resin was tested and proved satisfactory. (auth)

23677 STUDY OF THE EFFECT OF AN ANNEAL IN OXYGEN FOR ONE YEAR AT 500 DEG C ON THE TRACTION RESISTANCE PROPERTIES OF THE ALLOYS Zr – 0.5Cu – 0.5W. Oestberg, Gustaf; Attermo, Robby (Aktiebolaget Atomenergi, Stockholm). Compt. Rend., Ser. C, 262: 444-6(Feb. 7, 1966). (In French).

The effects of prolonged thermal treatments at 500°C in oxidizing and neutral atmospheres on the evolution of plasticity at room temperature of a zirconium alloy with 0.5% Cu and 0.5% W were compared. Brittleness was important and increased continuously with the duration of the thermal treatment with no saturation effect after a year's exposure in oxygen. The elastic limit bends of the traction curves of the oxidized samples were attributed to rupture of the oxide layer. (tr-auth)

23678 THE PROCESS OF RECRYSTALLIZATION OF BERYLLIUM COMPRESSED PARALLEL TO THE DRAWING AXIS. Gasc, Claude; Charrier, Jacques; Sarrazin, Serge; de Fouquet, Jacques (Ecole Nationale Superieure de Mecanique et d'Aerotechnique, Vienna). Compt. Rend., Ser. C, 262: 455-8(Feb. 7, 1966). (In French).

The recrystallization of hot-worked, cast, and drawn beryllium was studied by measuring hardness and micrography as a function of the conditions of initial deformation. The different regions of restoration, recrystallization, and grain growth were determined between 650 and 800°C in order to define the best conditions for obtaining a stable and homogeneous structure with fine grains starting with the crude drawing state. (tr-auth)

23679 OBSERVATIONS ON THE NATURE OF NEW CRYSTALLINE FORMS OF RARE EARTH SESQUIOXIDES STABLE ABOVE 2000 DEG C AND ON THEIR TRANSFORMATIONS. Foex, Marc; Traverse, Jean-Pierre (Centre National de la Recherche Scientifique, Montlouis, France). Compt. Rend., Ser. C, 262: 743-6(Feb. 28, 1966). (In French).

The values of the crystalline parameters of the A and H hexagonal forms were compared in the case of various rare earth sesquioxides. The thermal effects accompanying the transformation of the H form and one of the four other presently known crystalline forms of these oxides were also studied. The A–H transformation has certain analogies with the α-β transformation of quartz. The oxides of Sm, Eu, Dy, Ho, La, Pr, Nd, Gd, Tb, Er, Yb, and Y were studied. (tr-auth)

23680 A NEW FAMILY OF SULFUR-CONTAINING COMPOUNDS OF RARE EARTHS OF THE GENERAL FORMULA $L_4Ge_3S_{12}$ WITH L = La to Gd. Michelet, Annick; Laruelle, Pierre; Flahaut, Jean (Univ., Paris). Compt. Rend., Ser. C, 262: 753-5(Feb. 28, 1966). (In French).

Compounds with the formula $L_4Ge_3S_{12}$ or $L_4(GeS_4)_3$ were obtained by combination of the germanium and sulfur with the sulfides L_2S_3 of the rare earths. These compounds exist only from La to Gd. Their crystalline system is rhombohedric of the space group $R\ \bar{3}\ c$ or $R\ 3\ c$, according to the analysis of the Weissenberg diagrams. The elementary cell contains two molecules. The parameters of the six compounds prepared (La, Ce, Pr, Nd, Sm, and Gd) are given. (tr-auth)

23681 OBSTRUCTED PILE-UPS OF DISLOCATIONS IN Mo–Re ALLOY. Demkin, Yu. I. Fiz. Metal. Metalloved., 18: 930-3(1964).

The decrease in the γ-energy of the packing defect with an increase in Re concentration is believed to be a factor in the increase in the plasticity of Mo and W when they are alloyed with Re. Specimens cut from a monocrystal rod of Mo–35 at.% Re were subjected to impact deformation at room temperature, electrolytically polished, and pickled in a solution of H_2SO_4 in methyl alcohol. The subboundaries and the pile-up of etch pits around the scratch marks and indentations of microhardness and discretely constructed slip bands and slip lines were revealed. Only the pile-up of dislocations in front of the twin bands, which remain in the crystal following an elastic twinning, were studied. The alloy was found to contain two types of such pile-ups of dislocations: those with an inherent transverse slip, and those without that slip. This conflicts with the findings of other investigators whose electron microscopic examination of foils of Mo–35 at.% Re alloy revealed only pile-ups of the

first type, with a distinct transverse slip, in front of the twins. Therefore, the experiments were repeated and it was found that in the process of production of the foil the dislocation structure becomes altered; the nature of the movement of dislocations in a thin foil differs markedly from the movement excited by mechanical loading in bulky specimens. Thus, experimental proof that the alloying of Mo with Re reduces the packing-defect energy was obtained. (TCO)

23682 MAGNETIC PROPERTIES OF Er–Sc ALLOYS. Pop, I.; Chechernikov, V. I.; Naumkin, O. P.; Savitskii, E. M. (Moscow State Univ.). Fiz. Metal. Mettaloved., 19: 466-8(1965).

Procedures used in the preparation of test specimens of Er–Sc alloys are described. Studies on the temperature dependence of the magnetic permeability indicated it is possible that an antiferromagnetic exchange reaction occurs in these alloys as in alloys of Er–Y. In alloys with a high content of erbium, antiferromagnetism is basically conditioned by the properties of erbium among which there is a complex spin-spiral structure in which antiferromagnetic reactions occur in addition to the positive reactions. The paramagnetic properties of these alloys are basically conditioned by the localized *f*-electrons whereby the change of permeability follows the Curie-Weiss law, with a term independent of temperature. This causes a sharp reduction in the slope of $1/\chi$-to-T curves. Any conclusions concerning the existence of antiferromagnetism in alloys with high contents of scandium would be premature even though the Curie paramagnetic point is less than zero. (CFSTI)

23683 PHASE DIAGRAM AND CERTAIN PROPERTIES OF ALLOYS OF THE Nb–Mo–Si SYSTEM. Savitskii, E. M.; Baron, V. V.; Bychkova, M. I.; Bakuta, S. A.; Gladyshevskii, E. I. Izv. Akad. Nauk SSSR, Metal., No. 2, 159 66(1965).

The phase composition and oxidation resistance of 117 alloys of the Nb–Mo–Si system were investigated. The composition of the alloys tested corresponded to the $NbSi_2$–$MoSi_2$, NbSi–MoSi, Nb_5Si_3–Mo_5Si_3, Nb_3Si–Mo_3Si, Nb–$MoSi_2$, Mo–$NbSi_2$, and (Nb, Mo)–Si sections of the ternary diagram. No ternary compounds were found in the system. The $NbSi_2$ and $MoSi_2$ disilicides form a quasi-binary eutectic-type system with a limited solubility of the components; $NbSi_2$ dissolved 24 at. % Mo (72 mole % $MoSi_2$) and $MoSi_2$ dissolved 3 at. % Nb (about 9 mole % $NbSi_2$). Between the high-temperature modification β-Nb_5Si and the Mo_5Si_3 a mutual isomorphous substitution of Nb and Mo atoms occurs in the lattice of the compounds in the entire concentration range. In annealed alloys the Nb_5Si_3 compound was in the form of a low-temperature modification α-Nb_5Si_3. At 800°C, there were limited solid solutions: α-Nb_5Si_3 containing about 2 mole % Mo_5Si_3, and Mo_5Si_3 containing 60 at. % Nb (96 mole % Nb_5Si_3). The Mo_3Si compound dissolved up to 20 at. % Nb. The Nb_4Si compound was found to exist in pure form and also in equilibrium with a Nb-base solid solution in the cast and annealed alloys. The Nb_4Si compound dissolved little or no Mo, and did not form at a Mo-content higher than 4 at. %. In $NbSi_2$–$MoSi_2$ alloys the hardness of the $NbSi_2$ compound varied from 460 to 800 kg/mm^2. The high-temperature modification of the Nb_5Si_3 compound had a hardness of 840 kg/mm^2; the low-temperature modification had the highest hardness—1100 kg/mm^2. The oxidation resistance of the $NbSi_2$ compound increased with additions of up to 5 at. % Mo. The $MoSi_2$ compound alloyed with 0.5 wt.% Nb had the highest oxidation resistance; in air at 1200°C its weight gain was 0.05 $mg/cm^2 \cdot hr$. (CFSTI)

23684 DIAGRAM OF THE PHASE EQUILIBRIUM OF THE INTERMETALLIC SYSTEM $NbCr_2$–$ZrCr_2$. Kornilov, I. I.; Alisova, S. P.; Bydberg, P. B. Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 2205-7(Dec. 1965). (In Russian).

A section of the ternary system Nb–Zr–Cr between the intermetallic compounds $NbCr_2$ and $ZrCr_2$, which are AB_2-type Laves phases with a polymorphous transition was studied. High-temperature thermal analysis and x-ray phase and microstructural analyses were employed. The phase diagram obtained was characteristic of a system with a continuous series of solid solutions. A comparison of $NbCr_2$ and $ZrCr_2$ showed the same lattice type and only slight differences in lattice constants; in addition, the atomic similarity of the elements and the closeness of the stoichiometric composition led to the conclusion that a continuous series of solid solutions is formed between both the low-temperature and high-temperature modifications of these compounds. (ATD)

23685 WETTING OF TUNGSTEN WITH LIQUID ALUMINUM OXIDE. Elyutin, V. P.; Kostikov, V. I.; Levin, V. Ya.; Maurakh, M. A.; Mitin, B. S. (Inst. of Steel and Alloys, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 2208-11(Dec. 1965). (In Russian).

The wetting of tungsten and molybdenum with liquid Al_2O_3 and of tungsten with a liquid Al_2O_3–SiO_2 mixture was studied by placing a drop of the liquid oxide or mixture on a plate of rolled W or Mo. The drop was allowed to spread, the temperature was quickly lowered, and the area covered by the oxide was measured. A formula was derived for the dependence of this area on the mass of the drop in the absence of interaction between the liquid and solid and for small equilibrium contact angles: $m = \rho\pi r^3 \sqrt{k \cos\theta - 2}$ and $m = (\rho/\sqrt{\pi}) \sqrt{k \cos\theta - 2} \cdot S^{3/2}$, where S is the area of spread. S was calculated from this formula for the systems W–Al_2O_3, W–Al_2O_3–SiO_2, and Mo–Al_2O_3, and was compared with the measured values. It was shown that as the interaction between the solid and liquid increases, the discrepancies between the two sets of values become more appreciable: in the case of Mo–Al_2O_3, the deviations from the calculated curve were much greater than in the case of W–Al_2O_3, because the effective charge of Mo was greater than that of W. (ATD)

23686 OXIDATION RESISTANCE OF DISPERSION-STRENGTHENED TUNGSTEN AND COPPER. Opara, B. K.; Zhuk, N. P. Izv. Vyssh. Ucheb. Zaved., Tsvetn. Met., No. 2, 136-9(1965).

The oxidation behavior of tungsten strengthened with 0.7–5.0% ThO_2, or 1.0% La_2O_2 at 700, 800, and 900°C, and of copper strengthened with 1–10% MgO, 1–3% ZrO_2, 3% Al_2O_2, or 1–5% BN at 800°C was investigated. It was found that both ThO_2 and La_2O_3 intensify tungsten oxidation at all the temperatures tested. The oxidation rate of tungsten strengthened with thorium oxide was almost linear, and that of tungsten strengthened with lanthanum oxide was parabolic. Small additions of magnesium, aluminum, or zirconium oxides or boron nitride reduced the oxidation rate of copper owing to the increase in density of the Cu_2O crystal lattice. (CFSTI)

23687 ELASTIC CONSTANTS OF SINGLE-CRYSTAL BeO AT ROOM TEMPERATURE. Bentle, G. G. (Atomics International, Canoga Park, Calif.). J. Amer. Ceram. Soc., 49: 125-8(Mar. 21, 1966).

The five elastic constants of single-crystal BeO were measured to determine their magnitude relative to those of other hexagonal materials and to enable a correlation with related properties. The pulse-echo method was used. The stiffness constants are c_{11} 4.70, c_{12} 1.68, c_{13} 1.19, c_{33} 4.94, and c_{44} 1.53×10^{12} dynes/cm^2. These were related to the Young's, shear, and bulk moduli of polycrystalline BeO, the Debye temperature, and the repulsion term for the crystal energy. (auth)

23688 OXYGEN EXCHANGE AND DIFFUSION IN CALCIA-STABILIZED ZIRCONIA. Simpson, L. A.; Carter, R. E. (General Electric Research and Development Center, Schenectady, N. Y.). J. Amer. Ceram. Soc., 49: 139-44(Mar. 2, 1966).

Oxygen diffusion was measured by the sectioning technique on single-crystal and polycrystalline specimens of $Zr_{0.858}Ca_{0.142}O_{1.858}$. The diffusion coefficient, which may be represented by the equation $D = 0.018^{+0.022}_{-0.013} \exp -(31{,}200 \pm 4300)/RT$ cm^2/sec agrees with that calculated from the electrical conductivity and an oxygen transport number of 1. The oxygen surface exchange coefficient may be represented by $\alpha = 0.078^{+0.443}_{-0.068} \exp -(22{,}800 \pm 4400)/RT$ cm/sec. The quantitative influence of ignoring the exchange rate on the apparent diffusion coefficient is discussed. (auth)

23689 SINTERING KINETICS OF BERYLLIA. Clare, T. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales, Australia). J. Amer. Ceram. Soc., 49: 159-65(Mar. 21, 1966).

Compacts of sulfate-derived beryllia were sintered, for various times, in nitrogen at 1050 to 1500°C. The applicable equation for densification is $P = 0.5 - (1.2 \times 10^6/T) \exp [(-31{,}000)/RT] \log_e t$. This is predicted by the Coble intermediate-stage volume diffusion sintering model for material showing the observed $(\text{time})^{1/3}$ dependence of grain size on time. Apparent diffusion coefficients for sintering are near those for oxygen diffusion in BeO but it was not possible to make a firm conclusion on the rate-controlling ionic species. The activation energy for diffusion differs from that for grain growth; therefore the relation between porosity and grain size is not independent of temperature. Mathematical analysis shows that under certain conditions there may be an optimum temperature at which a required density can be attained with a minimum grain size. (auth)

23690 THERMOMECHANICALLY DEFORMED Y_2O_3. Brissette, L. A.; Burnett, P. L.; Spriggs, R. M.; Vasilos, T. J. Amer. Ceram. Soc., 49: 165-6(Mar. 21, 1966).

Improvements were found in optical and mechanical properties for press-forged polycrystalline yttria, and the mechanism of deformation was elucidated. Compressive press-forging of yttria was accomplished by placing the pressed ceramic between two refractory plungers similar to those used in ceramic die pressure sintering. Rod-shaped specimens (~0.060 in. in dia), were extracted radially from the forged structures by ultrasonic grinding techniques. Data taken on the (110) reflection planes for yttria showed relative beam intensity changes of more than two to one as a function of press-forging direction. These data, which show evidence of preferred crystallographic orientation suggest that plastic flow takes place in the press-forging operation. (P.C.H.)

23691 Fe–Nb OXIDES: PHASE RELATIONS AT 1180 deg C. Turnock, A. C. (Dept. of Mines and Technical Surveys, Ottawa). J. Amer. Ceram. Soc., 49: 177-80 (Apr. 1966).

Subsolidus phase relations of the oxides in the system Fe–Nb–O were experimentally determined at 1180°C, 1 atm total pressure, and variable partial pressures of oxygen. Niobium pentoxide reacted readily with either ferrous or ferric oxide at subsolidus temperatures and the following ternary compounds were synthesized: $Fe_4Nb_2O_9$, $FeNbO_4$, and $FeNb_2O_6$. It was found that the rutile structure of NbO_2 will take $FeNb_2O_6$ into solid solution and that the spinel structure of Fe_3O_4 will incorporate up to 7 at. % Nb. (auth)

23692 ELECTRONIC CONDUCTIVITY OF CALCIA-STABILIZED ZIRCONIA. Kroeger, F. A. (Univ. of Southern California, Los Angeles). J. Amer. Ceram. Soc., 49: 215-18(Apr. 1966).

The promotion of n-type electronic conduction by relatively small concentrations of donors in the presence of a large concentration of calcium, which is an acceptor, is explained by assuming that most of the calcium is present as neutral calcium ion-oxygen vacancy pairs or clusters. Evaluation of experimental data on the basis of this model leads to an enthalpy of pairing of calcium ions with oxygen ion vacancies of −2.7 ev. (auth)

23693 TEMPERATURE AND POROSITY DEPENDENCE OF YOUNG'S MODULUS OF POLYCRYSTALLINE DYSPROSIUM OXIDE AND ERBIUM OXIDE. Manning, W. R.; Marlowe, M. O.; Wilder, D. R. (Ames Lab., Ames, Iowa). J. Amer. Ceram. Soc., 49: 227-8(Apr.1966).

Linear least-squares fits of data obtained gave $24.72 \pm 0.05 \times 10^6$ psi as Young's modulus of nonporous dysprosium oxide and $27.01 \pm 0.49 \times 10^6$ psi as Young's modulus of nonporous erbium oxide. In terms of the relative Young's modulus, E/E_D, where E_D is Young's modulus of the nonporous material and E is Young's modulus of the porous material, the linear least-squares fits gave the following relations: for Dy_2O_3, $E/E_D = 1 - 2.44$ P, and for Er_2O_3, $E/E_D = 1 - 2.36$ P, where P is the volume fraction porosity. The relative elastic moduli of Dy_2O_3 and Er_2O_3 are plotted as functions of temperature. (P.C.H.)

23694 ELECTRICAL-RESISTIVITY CHANGES DURING JERKY FLOW IN BERYLLIUM COPPER. Woodford, D. A. (Univ. of Birmingham, Eng.). J. Inst. Metals, 94: 134-5 (Apr. 1966).

Measurements of resistivity changes were made during deformation in the jerky flow range of a low-carbon iron and a commercial Cu–Be alloy containing 2.06% Be and 0.25% Cu. Small increases in resistance were detected coinciding with each jerk during deformation of the Fe–C alloy. These were very small and could be substantially accounted for by the overall dimensional change following the sudden elongation A Be–Cu specimen was held at 200°C for 24 hr following quenching and subsequently tested at that temperature. In this condition the resistance increase was more pronounced and found to vary approximately linearly with the magnitude of the stress drop. However, after 10 jerks subsequent increases in resistance were reduced to the same order of magnitude as in the unaged specimen. Just before fracture the increase was again comparable to that at the start of the test. Possible mechanisms are discussed. (P.C.H.)

23695 EFFECT OF FINE DISPERSE Al_3Zr ON RECRYSTALLIZATION OF ALUMINIUM. Ryum, Nils (Norges Tekniske Hogskole, Trondheim, Norway). J. Inst. Metals, 94: 191-2(May 1966).

Recrystallization in aluminum containing 0 to 0.5 wt % Zr was followed with the aid of hardness determinations and the microscope. A substantial rise in recrystallization temperature, increasing with increasing zirconium content to a maximum effect at ~0.5 wt % Zr was found. A decrease in recrystallization rate in one batch that was not heat-treated before deformation was due primarily to the presence of Zr in supersaturated solid solution, whereas a much larger decrease in a heat-treated batch was due to finely dispersed Al_3Zr particles produced by precipitation during the 6 hr anneal at 500°C. (P.C.H.)

23696 VEINING SUBSTRUCTURE IN SINGLE-CRYSTAL DIMOLYBDENUM CARBIDE. Mersol, S. A.; Vahldiek, F. W.; Lynch, C. T. (Air Force Materials Lab., Wright-Patterson Air Force Base, Ohio). J. Less-Common Metals, 10: 373-88(June 1966).

Optical and electron microscopy on dimolybdenum carbide single crystals revealed a veining substructure on all planes of the as-grown crystals. Electron diffraction showed these veins to be hexagonal Mo_2C, determined by chemical and electron microprobe analyses to be off-stoichiometric $Mo_2C_{0.97}$. Annealing in vacuum at 1600 to 2000°C decreased the number of veins present. A substructure transition from veins to bands was observed after annealing at 2000°C, associated with γ'-MoC and Mo formation. Annealing at 2200°C or above caused the formation of bands found to be primarily Mo. The veining process is postulated to be due to a solidification and precipitation process. Polygonization of the veining substructure occurred during annealing below 2200°C. Room-temperature microhardness data on as-grown and annealed crystals further substantiated these findings. (auth)

23697 LIQUID DENSITIES OF CERIUM AND NEODYMIUM METALS. Rohr, William G. (Monsanto Research Corp., Miamisburg, Ohio). Contract AT-33-1-GEN-53. J. Less-Common Metals, 10: 389-91(June 1966).

The density of liquid neodymium and additional data on the density of liquid cerium were determined by a vacuum-pycnometric method as a function of temperature. For neodymium, liquid-density measurements made from near its melting point to 1231°C exhibited a temperature dependence expressed as: $Q = [7.373 - (5.28 \times 10^{-4})(°K)] \pm 0.019$ g/cm³. Liquid cerium density measurements were extended to 1173°C. The combined cerium data yielded a temperature dependence that could be expressed as: $Q = [6.930 - (2.27 \times 10^{-4})(°K)] \pm 0.027$ g/cm³. (auth)

23698 PRECIPITATION HARDENING IN AN EQUI-ATOMIC NIOBIUM–ZIRCONIUM ALLOY. Hughes, E. J.; Johnson, A. A.; Barton, P. W.; Drangel, I. (Mate-

rials Research Corp., Orangeburg, N. Y.). J. Less-Common Metals, 10: 408-15(June 1966).

Tensile specimens of an equiatomic niobium–zirconium alloy were solution-treated at 1150°C, quenched, aged individually for one hour at a temperature between 50 and 750°C, and tested at room temperature. The results obtained suggested that the aging temperatures can be divided into three ranges, each of which yields load-elongation curves of a characteristic shape. These three ranges can be understood in the light of the equilibrium and metastable phase diagrams for this system. In Range I, which extends up to about 300°C, the β-phase retained on quenching tends to dissociate into a metastable mixture of the hexagonal ω-phase and a niobium-rich β-matrix. In Range II, which extends from about 300 to 600°C, the β-phase tends to dissociate into the α_{Zr} and β_{Nb} terminal solid solutions, and in Range III, which is above the eutectoid temperature (600°C), it tends to dissociate into conjugate β_{Zr} and β_{Nb} solid solutions. These correlations between the changes of mechanical properties on aging and the structural changes predicted by the equilibrium and metastable phase diagrams provide a partial understanding of precipitation hardening in this alloy that will be used as a starting point for more detailed future studies. (auth)

23699 ALLOYS OF THORIUM WITH CERTAIN TRANSITION METALS. IV. THE SYSTEMS THORIUM–IRON AND THORIUM–COBALT. Thomson, J. R. (Imperial Coll. of Science and Tech., London). J. Less-Common Metals, 10: 432-8(June 1966).

The thorium–iron and thorium–cobalt systems were studied over the whole range of compositions at temperatures between 800°C and the liquidus. In the thorium–iron system the occurrence of four intermetallic compounds was confirmed. Th_7Fe_3, $ThFe_3$, and $ThFe_5$ were formed peritectically at 962 ± 12, 1200 ± 12, and 1212 ± 12°C, respectively, while Th_2Fe_{17} crystallized directly from the melt at 1462 ± 12°C. Eutectics occurred between Th_7Fe_3 and $ThFe_3$ at 45 at.% iron and 875 ± 12°C and between Th_2Fe_{17} and iron at 94 at.% iron and 1412 ± 12°C. There was no evidence that any of the compounds exist over a range of compositions. The occurrence of five compounds in the thorium–cobalt system was confirmed. Th_7Co_3, ThCo, $ThCo_5$, and Th_2Co_{17} all crystallized directly from the melt at 1188 ± 12, 1137 ± 12, 1437 ± 12, and 1462 ± 12°C respectively while the composition of the compound previously designated $ThCo_{2.3}$ was found to be close to $ThCo_3$. It formed slowly by a peritectic reaction at 1125 ± 12°C. Eutectics occurred at 1100 ± 12°C between thorium and Th_7Co_3, at 1037 ± 12°C between Th_7Co_3 and ThCo, at 975 ± 12°C between ThCo and "$ThCo_3$" at 1300 ± 12°C between $ThCo_5$ and Th_2Co_{17}, and at 1387 ± 12°C between Th_2Co_{17} and cobalt. The compound $ThCo_5$ occurred over a range of composition of approximately 4 at.% at 1300°C decreasing to 2% at 1100°C. (auth)

23700 INFLUENCE OF MICROSTRUCTURE ON THE BEHAVIOR OF URANIUM ALLOYS DURING TEMPERATURE CYCLING CREEP EXPERIMENTS. Chamberlain, J.; Johnson, M. P.; Kench, J. R.; Young, A. G. (English Electric Co. Ltd., Whetstone, Eng.). J. Nucl. Mater., 10: 121-32(May 1966).

The results of subjecting dilute uranium alloy test-specimens to temperature cycling during steady-state creep are reported and discussed in terms of microstructure. A previous analysis of the thermal cycling behavior of CEGB uranium is shown to be applicable to dilute uranium–aluminum alloys consisting of a fine dispersion of intermetallic precipitates in a pure α-phase uranium matrix. Shakedown theory is inapplicable to dilute uranium–molybdenum alloys, in which two metallic phases coexist and an attempt is made to account for their behavior in terms of a strain-energy distribution theory. This predicts that thermal cycling behavior should be controlled by the continuous, or matrix, phase; specimens heat-treated to produce different matrix phases are shown to behave in a manner compatible with theory. (auth)

23701 ORIENTATION RELATIONSHIP BETWEEN THE GAMMA AND ALPHA STRUCTURES IN URANIUM–ZIRCONIUM ALLOYS. Hatt, B. A. (Fulmer Research Inst., Stoke Pages, Eng.). J. Nucl. Mater., 10: 133-41 (May 1966).

By suitable alloying the gamma phase of uranium can be made to transform directly to an alpha-like phase. The orientation relation between these phases was determined for U–Zr alloys. It is similar to that reported for the transformation of the body-centered cubic structure to hexagonal close-packed structure in zirconium. The relations of the metastable α' structure to α uranium are discussed. It is shown how a banded microstructure can develop by the transformation of γ along all crystallographically equivalent paths such that each band is twin-related to adjacent bands. (auth)

23702 STUDY OF THE LIQUIDUS CURVES AND THERMODYNAMIC PROPERTIES OF THE SYSTEMS SiO_2–ThO_2 AND SiO_2–ThO_2–UO_2. Lungu, S. (Institut de Physique Atomique, Bucharest). J. Nucl. Mater., 10: 155-9(May 1966). (In Rumanian).

Equilibrium diagrams corresponding to liquidus curves for the systems SiO_2–ThO_2 and SiO_2–ThO_2–UO_2 in hydrogen atmosphere are presented. The investigations evidenced a nonmiscibility range in the binary system and a zone of nonmiscibility in the ternary system which connect the nonmiscibility ranges of the binary systems for SiO_2–ThO_2 and for SiO_2–UO_2. A study was also made of the free energy curve in the SiO_2–ThO_2 system relative to pure liquid phases which gives the maximum values of 1 kcal/mole for the internal energy and the anomalies characteristic of silicates for the high concentrations of SiO_2. (auth)

23703 AN X-RAY DIFFRACTION STUDY OF THE VARIATION OF THE LATTICE PARAMETERS AND THEIR RATIO FOR BERYLLIUM OXIDE AT TEMPERATURES UP TO 2000 DEG C. Baldock, P. J.; Spindler, W. E.; Baker, T. W. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 10: 160-72(May 1966). (AERE-R-4471).

Accurate measurements of the variation of the lattice parameters of beryllium oxide with temperature were obtained, using a high temperature x-ray diffractometer and least-squares analysis. The expansions of the a- and c-axes can be expressed by quadratic functions of t, where t is the temperature in °C. The measurements show that the axial ratio decreases with rise in temperature. (auth)

23704 EFFECTS OF HIGH PRESSURE AND TEMPERATURE ON THE MICROSTRUCTURE OF ALPHA URANIUM. Lloyd, L. T.; Liptai, R. G.; Priddle, R. J. (Argonne National Lab., Ill.). J. Nucl. Mater., 10: 173-80(May 1966).

The pressure-temperature diagram for uranium was determined up to 57 kbar pressure. The temperature hysteresis for the $\alpha \rightleftharpoons \beta$ transformation is decreased by increasing hydrostatic pressure. Metallographic observations have shown that subgrains and plastic deformations in the alpha structure can be eliminated by slowly cooling samples, which are surrounded with liquid alkali metals, from the gamma phase temperature range at a pressure of 40 kbar. It appears that good single crystals of alpha uranium can be grown by the phase transformation technique at hydrostatic pressures greater than about 33 kbar. (auth)

23705 THE RECRYSTALLIZATION CHARACTERISTICS OF MAGNOX AL80. Bhattacharjya, A. K.; Vaughan, T. B. J. Nucl. Mater., 10: 187-9(May 1966).

The samples were hot rolled at 200°C to deformations up to 50% and annealed for 1 hr at 200, 300, and 400°C. Metallographic examination showed that all grains were equiaxed, indicating full recrystallization at all annealing temperatures. No twinning was observed after annealing at 300 and 400°C, but severe twinning was observed in all specimens annealed at 200°C that had been deformed more than 5%. A broad secondary recrystallization peak was found on annealing at 400°C and centered on ~30% deformation. (W.L.G.)

23706 REPORTED HIGH-TEMPERATURE SOLUBILITY OF URANIUM IN URANIUM MONOCARBIDE. Ervin, G. Jr.; Korst, W. L. (Atomics International, Canoga Park, Calif.). J. Nucl. Mater., 10: 193-5(May 1966).

The extent of solubility of U in UC has been expressed in four different sets of units by various authors. Unfortunately, errors have been made in making conversions from one set of units to another and a misinterpretation of the comparisons between the various measurements has resulted. The interconversion of the different sets of units used is clarified and a comparison is made of the various values that have been reported for the solubility limit. Also, some limitations of the experimental techniques that have been used are discussed. (W.L.G.)

23707 DELTA TO EPSILON TRANSFORMATION KINETICS IN THE PLUTONIUM-1 WT PERCENT GALLIUM ALLOY. Karlsson, R. H.; Pavlick, J. E. (Dow Chemical Co., Golden, Colo.). J. Nucl. Mater., 10: 198-200(May 1966).

The kinetics were studied by monitoring the change in electric resistance of the metal as a function of time. The fraction transformed vs time curves were plotted by assuming that a change in voltage drop was proportional to the change in transformation. Sigmoidal type curves were obtained in all cases, indicating the transformation occurs by nucleation and growth. Application of the Avrami theory suggests that the growth of epsilon phase into the delta phase in the wire specimens is unidirectional. (W.L.G.)

23708 INFLUENCE OF GRAIN SIZE ON THE TENSILE PROPERTIES OF HYDRIDED α-ZIRCONIUM. Coleman, C. E. (Atomic Energy of Canada Ltd., Chalk River); Hardie, D. J. Nucl. Mater., 10: 201-3(May 1966).

Samples containing 100 ppM H_2 were vacuum-annealed for various periods of time at 700°C to produce complete recrystallization and various amounts of grain growth and then slowly cooled to produce grain boundary hydrides. The fracture stress was reduced by approximately the same amount over the whole grain size range, while the ductility was markedly decreased at the larger grain sizes and tended to zero for very large grain diameters. The effect on the flow stress was only slight. The hydride is therefore not an effective strengthening agent when precipitated in the grain boundaries. (W.L.G.)

23709 DIFFUSION-CREEP IN ZIRCONIUM ALLOYS. Jones, R. B. (Berkeley Nuclear Labs., Eng.). J. Nucl. Mater., 10: 204-7(May 1966).

Estimates of the rate of diffusion creep for various Zr alloys are made and compared with available creep data. Although there is some evidence for grain boundary diffusion creep at 400 to 500°C, the estimates of the diffusion creep rates using equations are critically dependent on the values assumed for the diffusion coefficient and activation energy. However, it is concluded that Zircaloy-2 pressure tubes, working at 16,000 to 30,000 psi at 300°C, are likely to show diffusion creep strains approaching 1% in 100,000 hr when the grain size is ~12 μm. Also it would appear that a modest increase in the grain size would be effective in preventing this grain boundary diffusion creep. (W.L.G.)

23710 QUESTION OF THE GRAIN SIZE DEPENDENCE OF THE FLOW AND FRACTURE STRESS IN ALPHA URANIUM. Taplin, D. M. R. (Univ. of Melbourne, Victoria, Australia). J. Nucl. Mater., 10: 208-9(May 1966).

The factors that complicate the use of the Petch equation, which relates the flow stress and fracture stress to the reciprocal square root of the grain diameter, for alpha-uranium are discussed. Comparisons are made of experimental data obtained by the authors and other recent investigators. (W.L.G.)

23711 X-RAY DIFFRACTION INTENSITIES OF THE HIGH TEMPERATURE (β) PHASE OF BERYLLIUM OXIDE. Baker, T. W.; Baldock, P. J. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 10: 210-11(May 1966). (AERE-R-4467).

Investigations were performed on both Minox AAA BeO and BeO prepared from $BeSO_4$ by calcining at 1000°C. The phase transformation in the Minox AAA BeO was found to occur between 2050 and 2100°C and the intensities of the reflections from the β-phase are given. The phase transformation in the sulfate BeO occurred between 2100 to 2250°C. The phase change was observed to occur in the same manner in both specimens and the $\beta \rightarrow \alpha$ reversion occurred at about 50°C lower than the $\alpha \rightarrow \beta$ transformation. (W.L.G.)

23712 THERMODYNAMIC STUDY OF SOLID SOLUTIONS OF URANIUM OXIDE. I. URANIUM OXIDE–THORIUM OXIDE. Aitken, E. A.; Edwards, J. A.; Joseph, R. A. (General Electric Co., Cincinnati, Ohio). J. Phys. Chem., 70: 1084-90(Apr. 1966).

The activity of uranium dioxide in solid solutions of $Y_yTh_{1-y}O_{2+x}$ was measured by the transpiration method. The partial pressure of UO_3 gas in a carrier gas of dry air was obtained and related to the thermodynamic activity of UO_2 in the solution according to the equation UO_2(in solid soln) + $\frac{1}{2}O_2(g) \rightleftharpoons UO_3(g)$. The activity of UO_2 was found to decrease with an increase in thorium oxide content. The decrease was much greater if the solid solution contained interstitial oxygen. By means of an integral method for three-component systems, the UO_2 activity was calculated at the stoichiometric composition from published oxygen activity data and the measured UO_2 activity of a nonstoichiometric composition. The stoichiometric solid solution was found to be ideal in the region of 1300°C. The effect of interstitial oxygen, which caused negative departure from ideality, was explained in terms of localized interaction of the interstitial oxygen with the uranium ion. The free energy of formation data gave a predicted composition, consistent with x-ray diffraction results, for precipitation of U_3O_8 phase from the solid solution at 0.2 atm of oxygen. (auth)

23713 THERMODYNAMIC STUDY OF SOLID SOLUTIONS OF URANIUM OXIDE. II. URANIUM OXIDE–YTTRIUM OXIDE. Aitken, E. A.; Joseph, R. A. (General Electric Co., Cincinnati, Ohio). J. Phys. Chem., 70: 1090-7(Apr. 1966).

The activity of uranium dioxide in solid solutions of $U_yY_{1-y}O_{2-x}$ along a selected composition line was measured by the transpiration method. The partial pressure of UO_3 gas in a carrier gas of air (0.2 atm of O_2) or CO_2–CO mixture was obtained between 1200 and 1700°C and related to the UO_2 activity of the solid solution according to the equation UO_2(in solid soln) + $\frac{1}{2}O_2(g) \rightleftharpoons UO_3(g)$. A large negative departure from Raoult's law was obtained at 1300°C. The UO_2 activity measured at two different oxygen partial pressures differed significantly. However, if the solid solution was visualized as a pseudobinary mixture of UO_{2+x} and $YO_{1.5}$, the effect of oxygen pressure on the activity could be largely eliminated. The results could then be expressed according to a binary regular solution model with an attractive interaction energy term of about 41 kcal. The linear relation between log activity coefficient and $(1-y)^2$ appeared to be independent of the average valence and the degree of anion deficiency. Examination of the enthalpy and entropy of vaporization indicated that the regular solution model did not properly describe the enthalpy and entropy changes on mixing; however, qualitatively these differences were largely the result of volume changes on mixing, which the regular solution model ignores. Additions of ZrO_2 to solid solutions of uranium oxide–yttrium oxide caused an increase in UO_2 activity but no change was observed with ThO_2 additions. (auth)

23714 AIR FORCE MATERIALS LABORATORY SYMPOSIUM ON BERYLLIUM. Kojola, Kenneth L. Light Metal Age, 23: Nos. 5-6, 10-15(June 1965).

The brittleness of Be and its relation to the purity of the alloy was studied extensively in attempts to increase prismatic and basal glide strains in single crystals, and to activate a room temperature slip system with a vector along

the c axis to permit c-axis contraction. Research is also in progress on fracture mechanisms in Be single crystals where the main contribution of purification is a delay in the initiation of rapid crack growth. X-ray diffraction, electron microscopy, and transmission electron microdiffraction were used to identify inclusions in Be, including intermetallic fcc compounds Be13M (where M = Mg–Ca, Zr, Mg, La, Ce, Th, and U), or body-centered tetragonal compounds Be12X (where X = V, Cr, Mn, Nb, Mo, Ta, W, and Ag), mineral compounds such as the carbides and oxides of Be, and free elements such as Al and Si. In the manufacture of Be sheet, forgings, extrusions, castings and wire, control of purity, grain size, preferred orientation and texture influences the ductility, strength, and anisotropy. Extensive programs are underway to evaluate Be for possible utilization in aircraft gas turbines, especially in the fan or compressor section. Other load carrying aerospace structures are being fabricated from Be such as the Be skin on missile guidance and control compartments and the Be panel outer-skin on the forward rack of the Agena vehicle. (Rev. Metal Lit.)

23715 STUDY OF THE ELECTRICAL AND SUPERCONDUCTIVITY PROPERTIES OF METALS WITH DIFFERENT PURITIES. PART I. Reich, Robert (Faculte des Sciences, Orsay, France). Mem. Sci. Rev. Met., 62: 801-27(Nov. 1965). (In French).

The production of pure metals by the zone-melting process is discussed, along with techniques and accuracy of resistivity measurements at a low temperature. Dimensional influences and principles of electrical resistivity at very low temperatures are reported for the cases of tin, aluminum, gallium, and beryllium. It was found that in a very pure metal, the residual resistivity is difficult to attain. (auth)

23716 ELECTRON-MICROSCOPE STUDY OF NIOBIUM CONTAMINATED AT AN ELEVATED TEMPERATURE BY INTERSTITIAL ELEMENTS. Bibring, H.; Jouffrey, B.; Girard, F. (Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux, France). Mem. Sci. Rev. Met., 63: 59-70(Jan. 1966).

A transmission technique examination of Nb specimens heated at 1,625°C under reduced pressure in air or nitrogen is described. More or less coherent fine precipitates are found with the solid solution, and also large precipitates resulting mainly from reaction with nitrogen. Some precipitates can block the dislocations. (auth)

23717 METASTABLE PHASES IN URANIUM–TITANIUM ALLOYS. Anagnostidis, M.; Baschwitz, R.; Colombie, M. (Compagnie pour l'Etude et la Realisation de Combustibles Atomiques, Bonneuil-sur-Marne, France). Mem. Sci. Rev. Met., 63: 163-8(Feb. 1966). (In French).

A study was made on the regions in which metastable phases exist in U–Ti, U–Mo, and U–Nb alloys. The behavior of titanium seemed to be different from that of molybdenum and niobium; this could possibly be explained by the relative position of these elements in the periodic table or by different relationships between uranium and titanium. (auth)

23718 CONTRIBUTION TO THE STUDY OF THE EMBRITTLEMENT, BY ALTERNATING PLASTIC DEFORMATIONS, OF A STEEL FOR NUCLEAR REACTOR VESSEL. Weisz, M.; Erard, M. (Commissariat a l'Energie Atomique, Saclay, France). Mem. Sci. Rev. Met., 63: 180-8(Feb. 1966). (In French).

The plastic fatigue strength in a low-alloy steel with Mn–Mo in the range from 20 to 400°C was studied. It was found that alternating deformation hardens and embrittles the steel by modifying the effective surface energy (Griffith-Orowan equation). Maximum embrittlement occurred between 200 and 300°C. (auth)

23719 DETERMINATION OF ELASTIC PROPERTIES OF STAINLESS STEEL AT HIGH TEMPERATURE IN DESIGNING FUEL SHEATHING PIPES FOR WATER REACTORS. Bray, A.; Colombo, R.; Balzari, Petruccioli. Met. Ital., 56: 210-12(June 1964). (In Italian).

A computer was used to determine, on the basis of experimental numerical values, the relations between: the unit load at the elastic limit of the piping material, Young and Poisson moduli and service temperature (300 to 400°C) to which pipes are subjected in a pressurized water reactor; the unit load at the plastic limit and permanent set; and the unit load at the plastic limit and temperature. These relations were then used to calculate the maximum external pressure that a pipe of the given material can withstand at the indicated operating temperature before collapsing in the elastically strained condition, as a result of instability, or in the plastically strained condition, as a result of yielding. (Rev. Metal Lit.)

23720 THE INFLUENCE OF ADDITIONS ON HOT DEFORMATION OF MOLYBDENUM MELTED BY ELECTRON BEAM. Booss, H. J.; Gerlach, J.; Hamel, H. J. (OSRAM GmbH, Berlin. Technische Univ., Berlin). Metall, 20: 123-6(Feb. 1966). (In German).

A series of molten Mo samples with additions of Zr, B, Re, misch metal, Si, and C was prepared and the trend of the hot deformation was studied. Structural modification, mechanical properties, and recrystallization behavior was investigated. The results showed that the addition of impurities affected the grain number per surface unit. The addition of B, Zr, and Si especially caused grain fining. The addition of Zr, Re, and C caused a decrease of the hardness that made it possible to work the metal without grain boundary fractures. Recrystallization studies showed that additions to Mo caused an increase of the hardness of the recrystallized Mo and an increase of the recrystallization temperature. The significance of these results was discussed. (J.S.R.)

23721 STRUCTURAL TRANSFORMATIONS IN 36NKhTYu TYPE ALLOYS WITH MOLYBDENUM. Smirnova, A. V.; Sol'ts, V. A. Metalloved. Term. Obrabotka Metal., No. 2, 2-6(1965).

Results are presented of a study of the mechanical and elastic properties and microstructure of 36NKhTYu type alloys with Mo alloy additions in relation to heat treatment. The chemical composition of the alloys is given in tabular form. Heat treatment of the specimens consisted of quenching from 950 to 1200°C and tempering at 600 to 850°C for 4 hr and longer. The structure was investigated by electron-microscopy with microdiffraction, x-ray diffraction, x-ray spectral and phase analyses, and by colored film etching. An analysis of the data on mechanical properties demonstrated that the addition of Mo to the 36NKhTYu alloy increased the strength and elasticity of the alloy after quenching and tempering (aging). Greatest hardening occurred at temperatures higher than those for the alloy alone. The Mo-containing alloys also had a greater relaxation resistance. It was also found that: in the 36NKhTYu alloys containing Mo, decomposition of the solid solution upon tempering (aging), with separation of the main hardening γ'-phase, occurs uniformly, unlike the situation in the alloy alone in which separation of the phase begins along the grain boundaries; alloying of the alloy with 5 and 8% Mo hardens the γ-solid solution as a result of the solution of about 4% Mo in it, increases the resistance of the main strengthening phase of the composition $(Ni,Fe)_3$ (Ti,Al,Mo) to coagulation and its transformation to the hexagonal phase Ni_3Ti, and effects the formation of a second hardening phase of the type Fe_2Mo. The presence of Mo in the alloys after optimal heat treatment conditions (quenching and tempering) of the hardened solid solution and the two hardening phases (γ'-phase and Fe_2Mo type phase) gave high strength and elastic properties to the specimens. (ATD)

23722 STUDY OF THE STRENGTH AND ELASTIC PROPERTIES OF THIN, NARROW BERYLLIUM BRONZE BrB2 BANDS. Timofeeva, Z. A.; Zhermunskaya, L. B. Metalloved. Term. Obrabotka Metal., No. 3, 33-6(1965).

The aim of the study was to determine the causes for the difference in properties of thin, narrow bands prepared from wires of different batches and to find ways of improving these properties. The bands were prepared from 0.2 mm wire made of beryllium bronze BrB2 and were tempered (aged) in a vacuum furnace. The physical and

mechanical properties of the metal bands (0.023 × 0.23 mm) were determined after deformation with an 83% reduction of area, and tempering. It was found that the mechanical properties of BrB2 bronze attained in microsections considerably surpass the properties in macrosections. The crystal lattice distortions and hot spots which appear during drawing and rolling cause a partial decomposition of the hardened solid solution, as indicated by a certain increase in electrical resistivity, and the appearance of faint lines of a segregated phase on x-ray patterns. The optimum tempering conditions for the bands after rolling are 270°C and 40 min; longer tempering causes impairment of mechanical properties. Elastic lag of the bands is considerably affected by oxide films which readily form on the surface of the bronze because of the presence of the reactive metal beryllium. Even multiple drawing did not completely remove the oxide. The elastic lag for bands made from wire with the oxide film removed was 0.05–0.04%, which is ½ the lag for bands rolled directly without removing the oxide film from the wire. (ATD)

23723 SOLUBILITY OF ZIRCONIUM IN THE FERRITE OF LOW-CARBON STEEL. Kuleshova, N. P.; Lutsyak, V. G. Metalloved. Term. Obrabotka Metal., No. 12, 43-4 (1964).

Five different steels with approximately the same carbon content were investigated to determine the distribution of zirconium between ferrite and the carbide phase, since there is no uniformity of opinion on the solubility of zirconium in α-iron. The studies were conducted at room temperature. The steels were made in induction furnaces and cast into 65 ingots. Zirconium was added as an alloy (a pressed mixture of fine iron shavings and metallic zirconium) containing 30–35% Zr. The method based on the change in the phase composition during transition through the solubility boundary was used. It was found that the maximum solubility of zirconium in the ferrite of low-carbon steel at room temperature did not exceed 0.14%. When the content of Zr exceeded its maximum solubility in ferrite, it was present as the free carbide, ZrC. The content of pearlite was lower than usual in this case in steels of the same chemical composition but without zirconium. (CFSTI)

23724 HEAT TREATMENT FOR IMPROVING THE NOTCH TOUGHNESS OF HEAVY SECTION Mn–Mo STEEL FOR NUCLEAR REACTOR VESSELS. Ando, T.; Susukida, H. Mitsubishi Heavy Ind. Tech. Rev., 3: 36-42(Jan. 1966). (In Japanese).

Fundamental and practical experiments on the effects of quenching, tempering, and stress relieving on the notch toughness of heavy section modified Mn–Mo steel for nuclear reactor vessels were carried out and the following results were obtained. The most important factor for the improvement of the notch toughness is to increase the cooling rate from austenitizing temperature. Stress relieving impairs the notch toughness. The critical cooling rate, at which the V Charpy impact value exceeds 5.2 kg-m/cm^2 (30 ft-lb) at −12°C (10°F) after quenching, tempering, and stress relieving, is about 10°C/min. The transition temperature Tr_{30} at one quarter of the thickness of a test plate after hot forming, quenching, tempering, and stress relieving was −30°C, and the NDT temperature was −25°C. From the above experimental results, the heat treatment procedures for fabricating high quality and heavy section nuclear reactor vessels can be established. (NSA of Japan)

23725 STUDIES ON THE TERNARY SYSTEMS: (V, Nb, Ta)–Cu–Al AND Ta–Ni–Cu. Oesterreicher, H.; Nowotny, H.; Kieffer, R. (Univ., Vienna). Monatsh. Chem., 96: 351-9(1965). (In German).

The equilibria of these systems were partially established using x-ray diffraction methods. The samples were prepared by sintering of the powder components. No ternary phase was detected for V–Cu–Al; however, there was some solubility of Cu aluminides in VAl_3 and V_5Al_8. Several ternary phases occurred within the Nb–Cu–Al system. One of these was the Laves phase $Nb(Cu,Al)_2$ with a large range of homogeneity. Formation of an irregular shift structure was observed with some alloys containing $Nb(Cu,Al)_2$. Structural elements of both the cubic and hexagonal type were present. The constitution of the Ta–Cu–Al system appeared to be very similar to the former ternary system. No ternary compound was found in the Ta–Ni–Cu system; however, there was an extended substitution of nickel by copper within the Ta–Ni phases. The Ta–(Ni,Cu) phases were in equilibria with (Ni,Cu) solid solutions. (auth)

23726 THE CRYSTAL STRUCTURE OF $Ta_6Cu_8Be_{15}$ AND RELATED PHASES. Ganglberger, E.; Nowotny, H.; Benesovsky, F. (Univ., Vienna). Monatsh. Chem., 96: 1206-8(1965). (In German).

Cold-pressed powder mixtures were heated several hr under gettered Ar at 1000 to 1200°C, for the series Ta–Cu–Be. The phase $Ta_6Cu_8Be_{15}$ was found, by its intensity series from a powder pattern and by its lattice parameter, to be isotypic with the Th_6Mn_{23} structure and is another example of ternary structures of this sort. Experimental and calculated intensities for a CrKα powder pattern are tabulated. The data indicated that in comparison with such similar structures as $Mg_6Cu_{16}Si_7$ the Be atoms occupy not only the Si positions but some of the metal positions as well. This was compared with behavior of Be in other systems. There is dense packing in the dodecahedron plane (110) in which gaps occur only at ¼ ¼ ~ ¼. Other similar systems were found and have the following lattice constants: $Ta_6Cu_8Be_{15}$, 10.77_5 Å; Ta–Cu–Be (Be-richer), 10.72_5; $Nb_6Cu_8Be_{15}$, 10.83_3; $Ti_6Cu_8Be_{15}$, 10.78_4; $Zr_6Cu_8Be_{15}$, 11.18_5; Hf–Fe–Si, 11.49_0; Hf–Co–Si, 11.37_8; Hf–Co–Ge, 11.56_2; Hf–Ni–Ge, 11.56_1; and Ta–Ni–Ge, 11.44_4. (BBB)

23727 MAGNETIC PROPERTIES OF THULIUM IN THE SESQUIOXIDE AND METAL STATES BETWEEN 0 AND 110 kOe AND AT 2 TO 1560 DEG K. Perakis, N.; Kern, F. (Univ., Strasbourg). Phys. Kondens. Mater., 4: 247-53 (1965). (In French).

Tm_2O_3 obeys the Curie-Weiss law $\chi_A(T + 25) = 7.08$ between 80 and 980°K with $\mu_{eff} = 7.56$ Bohr magnetons, the theoretical value for Tm^{3+} (J = 6, g = 7/6). In the behavior of the metal, $\chi_A(T - 14) = 7.45$ between 80 and 1540°K, a contribution of the nonlocalized electrons should be considered at high temperatures. The susceptibility of the metal is maximum at 53°K, minimum near 35°K, and the behavior is antiferromagnetic between these two temperatures, ferromagnetic below 35°K. An additional transition occurs near 10°K, vanishing by cooling in a magnetic field. The effect of this cryomagnetic treatment on the magnetization and the remanence was measured in six different cooling fields. The magnetization reaches 1.0 and 5.0 magnetons in 26.7 and 110 kOe (pulsed field) respectively, whereas the saturation for the ground state $^3H_6$ is gJ = 7. (auth)

23728 ALKALI IMPURITY RESISTIVITIES IN LIQUID SODIUM. Dickey, J. M. (Univ. of Ghana); Meyer, Axel; Young, W. H. Phys. Rev. Lett., 16: 727-9(Apr. 25, 1966). (ORNL-P-2023).

A test of the Faber-Ziman theory of the resistivity of binary liquid-metal alloys is presented specifically for dilute quantities of the various alkalis in Na at its melting point. Comprehensive tables of pseudoatom phase shifts relevant to this test are included. (B.G.D.)

23729 MACROETCHING OF MOLYBDENUM. Benesovsky, F.; Ihrenberger, A. (Metallwerk Plansee AG., Reutte/Tirol, Austria). Prakt. Metallog., 3: 32(Jan. 1966). (In German).

Molybdenum radiation protection screens used in ceramic-free high-temperature vacuum or protective gas ovens undergo strong crystalline growth after a long period of operation. The screens show 1-cm long crystals caused by an etching effect during the oven operation. Factors affecting grain growth are indicated. (J.S.R.)

23730 RELAXATION EFFECT DUE TO DIFFUSION OF INTERSTITIAL HYDROGEN IN TANTALUM AND NIOBIUM. Cannelli, Gaetano; Verdini, Livio (Istituto Nazionale di Ultracustica O. M. Corbino, Rome). Ric. Sci. Riv., 36: 98-105(Feb. 1966).

After the introduction of interstitial hydrogen into tantalum and niobium specimens by means of electrolytic charging, a dissipation peak, due to a relaxation process ther-

mally activated, was found below room temperature. For the diffusion of hydrogen in tantalum the activation energy was found to be W = 0.12 ev and the diffusion constant $D_0 = 1.9 \times 10^{-5}$ cm²/s. For niobium the activation energy is 0.18 ev and the diffusion constant $D_0 = 7.2 \times 10^{-3}$ cm²/s. (auth)

23731 TIG-WELDING OF ZIRCONIUM ALLOY ZrNb1. Marquardt, E. Schweisstechnik, No. 7, 309-13(1965).

Welding effects on ZrNb1 zirconium-base alloy were studied. Alloy specimens, 1 × 100 × 200 mm, vacuum annealed and pickled, were TIG welded with argon backing and additional shielding of the hot weld. The welding was done either manually with filler wire or automatically without filler wire. All the welds had a shiny silvery surface with a narrow discolored streak on both sides of the weld. An insignificant increase in hardness was observed in the heat-affected zone of the automatic weld, which disappeared completely after annealing at 585°C. In manual welds the hardness (HV15) reached 160 kg/mm² (compared to 105 kg/mm² for the base metal) and was reduced to about 125 kg/mm² by annealing. Mechanical properties of the welds were not affected by either the welding method or heat treatment. The tensile strength varied from 27 to 30 kg/mm², yield strength from 22 to 24 kg/mm², and elongation from 28 to 66%. In a 200-hr corrosion test in steam at a temperature of 400°C, the weight gain of manual welds amounted to 27.0–59.2 mg/dm² compared to 19.6–25.1 mg/dm² for automatic welds. (CFSTI)

23732 SINTERED CERAMICS FROM URANIUM DIOXIDE. III. URANIUM DIOXIDE DISPERSION AND ITS MICROAGGLOMERATE STATE. Podest, M.; Jakesova, L. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Silikaty, No. 1, 1-11(1965).

In order to study the dispersion and granulometric state of powdered UO_2 prepared from ammonium polyuranate, the specific particle surface area was established by the standard BET method based on its absorption of argon. Grain size, which is important in determining its compression and sintering properties, was analyzed on the basis of its fundamental structural unit, crystallite agglomeration. In order to avoid errors involved in previous methods of measuring grain size, an agglomeration coefficient was applied in which the average particle diameter d_B is derived from the specific surface area S; d_B is very small in UO_2 powder, ranging between 10^2 and 10^3 Å. This agglomeration coefficient is defined by: $\vartheta(d_B/d_{rtg})$, where: $d_B = (G/Q \cdot S)$ Q being the density (10.968 g/cm³ for UO_2) and S the specific surface area in m²/g, and d_{rtg} is the crystallite diameter, which ranges between 250 and 350 Å. The ideal surface area is between 16 and 21 m²/g and the specific area of nine UO_2 preparations lay between 15 and 19 m²/g. The number and area of contact between crystallites in an agglomerate can best be studied with an idealized model consisting of balls whose diameter equals d_{rtg} and which completely fill the agglomerate volume. Such a model of a UO_2 agglomerate should have a density of 10.968 g/cm³ and the maximum surface area is easy to calculate. The above coefficient will give the proportion of the surface which remains free and thus indicate the area of contact points. These values are tabulated for nine UO_2 powder preparations and their relation to the degree of agglomeration is indicated on a graph, from which a logarithmic solution is derived: $\log S_V = 2 - \log^{\vartheta}$ or $S_V = 100/\vartheta$, S_V being the free surface area and ϑ the above coefficient. Methods of establishing the number of crystallites in an agglomerate and the number of contacts per crystallite are also described and these values tabulated and charted for the nine UO_2 preparations. (ATD)

23733 RADIOCHEMICAL STUDIES ON THE DIFFUSION OF GOLD INTO SILICON. Martin, J.; Haas, E.; Raithel, K. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Solid-State Electron., 9: 83-5(Jan. 1966). (In German).

Activation analysis was combined with autoradiography to study the diffusion of gold into silicon crystals. The methods are described for neutron irradiation of the crystals with the formation of ^{198}Au which could be quantitatively measured by spectroscopy or qualitatively examined in the crystals by autoradiography. Analyses were conducted on sections of crystals 18 mm in dia and 300 μ thick. Diffusion of gold into silicon was conducted for 20-min periods at temperatures of 720, 830, and 900°C in a vacuum. Segregations of gold in the surface layers and in crystal disturbances were indicated by the concentration profiles thus obtained. This was confirmed by comparing photographs of etched surfaces with autoradiographs. Temperature and time dependence of the gold diffusion was studied using crystals of a medium dislocation density. At a temperature of 720°C the concentration of gold in inner layers of silicon reached 1.7×10^{11} atoms Au/cm³ Si. (BBB)

23734 THE ELECTRODIFFUSION OF TRACE ELEMENTS IN γ-CERIUM, γ-URANIUM AND ϵ-PLUTONIUM. Moore, R. H.; Burger, L. L. (Battelle Memorial Inst., Richland, Wash.). pp 89-103 of STI-PUB-109(Vol. 2).

Measurements of solid state diffusion, in an electric field, of various metals in trace concentrations were made using Ce, U, and Pu as solvent metals. An apparatus is described which permits sustained experiments in a controlled atmosphere under constant temperature conditions. Extensive data were obtained in the case of Ce in the temperature range of 490–650°C at current densities from 250 to 500 amp/cm² and over times up to 240 hr. Data are presented for a dozen solute elements. In the case of some transition elements, notably Fe, Co, and Ni, the migration is quite rapid. The use of radioactive tracers, where possible, provided data for quantitative treatment of the results. Spectroscopic analysis provided additional information. Migration rates in U measured at 900°C were lower and reduced even more in Pu at 500°C. However, it was still possible to measure a rate of electrodiffusion of Fe. No movement was detected for Sb, Mg, Mn, Si, or Zr. With the exception of Mo and Sn, the metals studied migrated towards the anode. Electrodiffusion presumably results from the net effect of the electric field acting on the ions and from momentum interchange between the ions and conduction electrons. The two effects may thus oppose or reinforce each other. It is felt that the field effect is greater in the cases studied. The tendency of the solute element to form a compound with the solvent metal is one measure of whether migration is to be expected. It is also shown that a relative size effect is important. An interesting aspect of the electrodiffusion of Fe in Ce is the very low (~ 2 kcal) activation energy. Some comparisons were made with chemical gradient diffusion. (auth)

23735 DIFFUSION OF BARIUM, STRONTIUM AND CERIUM IN VARIOUS GRADES OF REACTOR GRAPHITE. Faircloth, R. L.; Pummery, F. C. W.; Rolls, B. A. (Atomic Energy Research Establishment, Harwell, Eng.). pp 133-52 of STI-PUB-109(Vol.2).

Experiments designed to study the diffusion of barium, strontium and cerium in various grades of graphite are described. In these experiments specimens of the graphite were immersed in the vapor of the fission product metal under controlled conditions of temperature and pressure for known periods of time. After appropriate grinding and polishing, the distribution of the solute metal in the specimen was determined by means of an electronmicroprobe. The electronmicroprobe recordings were interpreted to obtain apparent values of the diffusion coefficients and their dependence upon temperature. The results indicate that migration occurs primarily via defects in the graphite structure, with only a negligible contribution from in-grain diffusion. The significance of the results is discussed, with particular reference to the differences in behavior encountered between various grades of graphite. (auth)

23736 CORRELATION OF THERMODYNAMIC AND ATOMIC TRANSPORT PROPERTIES. Swalin, R. A. (Univ. of Minnesota, Minneapolis). pp 197-211 of STI-PUB-109(Vol.2). (COO-841-5).

The rate of transport of a particular atomic species in a crystal is governed principally by the diffusion coefficient D which in turn is related to temperature by the following equation: $D = D_0 \exp(-Q/RT)$. From the activated state theory, Q is found to be equal to the sum of the enthalpy of formation of the principal defect promoting the transport

and the enthalpy of motion of the species. The term D_0 is given by: $D_0 = gd^2\nu \exp(\Delta S^{\ddagger}/R)$ where g, d and ν are a geometric constant, diffusion jump distance, and vibrational frequency respectively. $\Delta S^{\ddagger}$ is the entropy change associated with the defect formation and migration process. As a consequence, it is of principal interest to correlate the terms D_0 and Q with thermodynamic properties if possible. The following question is examined for metals and salts. Since atomic transport properties are often more difficult to measure than equilibrium properties, can the thermodynamic properties of a material be used to provide knowledge concerning the expected magnitudes of Q and D_0? The analysis is based on the following two levels. Since the thermodynamic properties of a system reflect the degree of stability of the system and since the magnitude of the enthalpy barrier for diffusion, Q, is governed by the same factors, useful empirical correlations are found to exist. Some of the correlations in the past for metals and alloys are presented. In addition some new correlations for compounds are presented. The thermodynamic properties of a system can be used by means of quasi-chemical theory to obtain numerical data concerning the bonding in a system. In turn, the bond energies may be used, according to various models, to provide information concerning the energetics involved in the diffusion process. Results of some of these calculations are presented. (auth)

23737 APPLICATIONS OF THE THERMODYNAMICS OF IRREVERSIBLE PROCESSES TO SOLID-STATE DIFFUSION. Adda, Y. (Centre d'Etudes Nucleaires, Saclay, France); Brebec, G.; Doan, N. V.; Gerl, M. pp 255-95 of STI-PUB-109(Vol.2). (In French).

In the study of the Kirkendall effect, the thermodynamics of irreversible processes were used to describe transport phenomena in metals and alloys, restricted to the case where migration is only by vacancies. The entropy source was calculated by using a mean velocity which makes explicit allowance for the vacancies: i.e., the mean atomic velocity. It is shown that the inclusion of vacancies in the thermodynamic analysis requires a source term which takes into account the fact that the vacancies can be created or destroyed at the crystal imperfections. The Kirkendall effect is described by means of general equations which relate the fluxes and forces. With the help of this formalism it is also possible to state the properties of the Kirkendall interface and predict the distribution of pores in the samples. From the general expression for the entropy source, equations are derived for diffusion under a temperature gradient and in an electric field expressing the different fluxes (atoms, vacancies, heat, electrons, etc.) as a function of the thermodynamic forces acting on the system. In the case of self-diffusion under a temperature gradient in α-iron, a vacancy flux towards the hot regions was observed, whereas no flux was observed in copper, gold, or silver. In view of this difference in behavior it was decided to determine the true concentration of vacancies in the system using the general criterion for the development of macroscopic systems established by Glansdorff and Prigogine. In the case of self-diffusion in an electric field the vacancy flux enables one to determine the effective valence, which may be compared with the theoretical value given by atomic models. The case of a dilute binary alloy was studied with satisfactory interpretation of the phenomenon and a practical method for determining the effective valences of the two constituents. (auth)

23738 COMPOSITION AND VACANCY FLUX EFFECTS IN TRACER DIFFUSION IN SILVER–GOLD ALLOYS. Meyer, R. O.; Slifkin, L. (Univ. of North Carolina, Chapel Hill). pp 297-309 of STI-PUB-109(Vol.2).

Self-diffusion studies in silver–gold alloys show that the activation energies decrease monotonically with increasing gold concentration. These results are not explained by theories based on corresponding states, size effects, or heats of solution; however, LeClaire's extension of Lazarus' electrostatic theory gives semiquantitative agreement. The decrease of the pre-exponential factors with increasing gold concentration indicates that the vacancy entropy of migration decreases linearly with composition by 1.5 R from pure silver to pure gold. For either tracer at a fixed temperature, the diffusion coefficient D versus composition exhibits a broad minimum. Using these data as a test of theories of vacancy-impurity interaction, only those of Manning and Lidiard give satisfactory and consistent results. Addition of the more mobile silver to the less mobile gold actually decreases D for both tracers; analysis indicates that the presence of a silver atom adjacent to a vacancy and a gold atom reduces the gold atom jump frequency by a factor of approximately 0.4. The existence of the broad minimum in the plot of D versus composition allows an investigation of the effect of a vacancy flux on tracer diffusion. A Kirkendall couple is prepared from compositions symmetrically displaced about the minimum. The interface contains a thin layer of gold tracer and is marked with fine particles of radioactive hafnium oxide. During the diffusion anneal the vacancy flux produces a drift of the center of mass of the gold tracer distribution, which remains undistorted since D is almost independent of position. The fine, inert marker locates the original interface to within several microns. Results indicate drifts of the center of the gold tracer distribution of approximately 20 microns toward the silver-rich end. (auth)

23739 MIGRATION AND RE-ORIENTATION OF OXYGEN INTERSTITIALS, AND MIGRATION AND SELF-DIFFUSION OF URANIUM IN UO_2. Nagels, P.; Van Lierde, W.; De Batist, R.; Denayer, M.; De Jonghe, L.; Gevers, R. (SCK–CEN, Mol-Donk, Belg.). pp 311-26 of STI-PUB-109 (Vol.2).

The first results of a study of some aspects of motion phenomena of uranium and oxygen ions in uranium dioxide are reported. The determination of the diffusion coefficients for uranium at 1300, 1450, 1465, and 1800°C, the measurement of the activation energies for migration of uranium point defects and oxygen interstitials and of the activation energy reorientation of oxygen interstitials are included. All measurements were performed on vapor-grown UO_2 single crystals. The self-diffusion coefficients for the ^{235}U ion in stoichiometric UO_2 were measured using the sectioning technique. The analysis of the gradient in the ^{235}U concentration after the diffusion anneals was made by grinding off thin layers of about 0.1 μm thickness and determining their ^{235}U content by γ-spectrometry after reactor irradiation. The D values obtained on UO_2 single crystals seem to agree well with the values measured by Auskern and Belle on sintered material. Combination of both experimental results yields an activation energy of (88 ± 6) kcal/mole for uranium self-diffusion in stoichiometric UO_2. The activation energies of migration for uranium and oxygen point defects were determined by studying the recovery of the electrical conductivity of slightly oxidized crystals after reactor irradiation and after quenching. Fission-fragment damage causes a marked decrease in conductivity, due to the formation of hole traps. Annealing experiments revealed the existence of an annealing peak around 725°C. The activation energy of migration associated with this recovery stage can be estimated to be (2.5 ± 0.3) ev. This suggests uranium point defect migration. Pulse annealing experiments were also performed on quenched UO_{2+x} crystals with compositions exceeding slightly the excess oxygen solubility limit at room temperature. Upon heating at temperatures above 110°C, the oxygen interstitials start migrating and form U_4O_9 precipitates. The activation energy for this migration process was found to be (0.9 ± 0.1) ev. Internal friction experiments with small UO_2 single crystals vibrated in transverse resonance revealed a damping peak around 255°K for a frequency of about 900 cps. Assuming this peak to be caused by an atomistic relaxation process, the activation energy can be estimated at about 0.5 ev. This value is too low to represent oxygen diffusion, and too high to represent the migration of charge carriers. A tentative explanation is presented based on the reorientation of oxygen interstitials. This rotation can occur without gross diffusion of the oxygen, and it is shown that this model can explain the changes in peak height observed as a consequence of different thermal treatments. (auth)

23740 EFFECT OF PRESSURE ON THE DIFFUSION RATES IN NOBLE METALS. Tomizuka, C. T. (Univ. of Arizona, Tucson). pp 327-31 of STI-PUB-109(Vol.2).

It is possible to find the activation volume, ΔV, for diffusion in solids by the thermodynamic relation: $(\partial \Delta G/\partial P)_T = \Delta V$, where ΔG is the Gibbs free energy for the process. In noble metals, self-diffusion rate measurement as a function of pressure at a constant temperature will then lead to the determination of the volume of a mole of vacancy in motion, since vacancy mechanism is established for these metals. Employing the standard technique of using a radioactive tracer and lathe sectioning, one can determine the diffusion rates in specimens subjected to diffusion runs at high temperature and at high pressures generated within a vessel containing pressurized gas. The activation volume for self-diffusion in gold was thus found to be 7.2 cm^3/mole and that for self-diffusion in silver was found to be 9.3 cm^3/mole. It is possible to apply the same method to study the diffusion of impurities in an otherwise pure crystal. Diffusion of indium and antimony in silver was studied as a function of pressure. The results agree well with the screening theory developed by Lazarus and LeClaire. (auth)

23741 CONTRIBUTION TO THE STUDY OF DIFFUSION IN THE U–Cr–Si–Al SYSTEM. Casteels, F. G. (Centre d'Etude de l'Energie Nucleaire, Brussels). pp 333-47 of STI-PUB-109(Vol.2). (In French).

A good bond between core and sheath is required in a number of metallic fuel elements. The mechanism of intermetallic phase formation by interdiffusion was studied in a system with several constituents. The investigation was carried out on the interdiffusion between aluminum covered by a layer of silicon (8–11 μm) and uranium covered by a layer of chromium (8–23 μm), the silicon and chromium constituting the diffusion barrier. The mechanisms of diffusion, the formation of intermetallic phases, and various laws of diffusion and penetration for pure metals and binary, ternary and quaternary couples are discussed. From this discussion and from the results obtained it may be concluded that the diffusion of the aluminum in the uranium through the diffusion barrier results from the process whereby binary (aluminum–chromium) and ternary (Al–Si–Cr) intermetallic phases are formed and transformed. Structural defects in the intermetallic phases formed or deformations may be the cause of the low activation energies observed during the study of diffusion in the quaternary system. (auth)

23742 PHASE RELATIONS IN THE URANIUM–URANIUM DIOXIDE SYSTEM AT HIGH TEMPERATURES. Edwards, R. K.; Martin, A. E. (Argonne National Lab., Ill.). pp 423-9 of STI-PUB-109(Vol.2).

Data from the literature plus extensive new work permit the delineation of a substantial portion of the temperature-composition phase diagram for the uranium–uranium dioxide system. Of particular interest to the many current investigations of the thermodynamic and transport properties of urania as a function of its stoichiometry is the compositional existence range of hypostoichiometric uranium dioxide. The essential features of the phase diagram presented are: A wide liquid miscibility gas exists at temperatures above 2470 ± 25°C; which is the monotectic temperature in the system. At the monotectic temperature, the compositions in O/U atom ratio units of the three condensed phases in mutual equilibrium are: liquid uranium, 0.05 ± 0.01; monotectic liquid, 1.30 ± 0.10; and solid hypostoichiometric uranium dioxide solid, 1.60 ± 0.02. The hypostoichiometric phase boundary in the range 1600 to 2470°C can be expressed by the equation: $\text{Log}X_U = 1.404 - 5769/T$, in which X_U is the mole fraction of uranium dissolved in a stoichiometric uranium dioxide, and T is in degrees Kelvin. From this equation, the heat of solution of uranium in uranium dioxide is 26.5 kcal/mole. No evidence was observed for the existence of stable phases intermediate to the liquid uranium and solid hypostoichiometric uranium compositions. (auth)

23743 HIGH-TEMPERATURE HARDNESS OF WC, TiC, TaC, NbC AND THEIR MIXED CARBIDES. Miyoshi, Akiyoshi; Hara, Akio. Sumitomo Elec. Tech. Rev., No. 7, 68-73(Feb. 1966).

High temperature hardness of various carbides was measured to analyze the hardness of cemented carbides at high temperatures. Sintered carbide specimens having a grain size of about 100 microns were made. The hardness was measured up to 1,200°C by a micro-Vickers hardness tester. Titanium carbide showed lower hardness at elevated temperatures in spite of high hardness at room temperature, tungsten carbide showed low hardness, and tantalum and niobium carbides showed high hardness at elevated temperatures. Mixed carbides (WTiTa)C, showed higher hardness not only at room temperature but also at elevated temperatures. However, the mixed carbides were much more brittle than single carbides. These phenomena are discussed in some detail, comparing them with the properties of cemented carbides. (auth)

23744 THE EFFECT OF VACUUM ROLLING ON THE STRUCTURE AND GAS-SATURATION OF TITANIUM AND MOLYBDENUM. Smirnov, V. S.; Tron, A. S.; Aleksandrov, A. A.; Vitorskii, Ya. M.; Rybal'chenko, N. D. Tr. Leningr. Politekh. Inst., No. 238, 90-4(1964). (In Russian).

Billets of a Ti alloy with 4% Al rolled in a 230 mill were investigated. The effects of vacuum rolling on structure and on gas content and distribution in Ti and the influence of heating and rolling conditions on the thickness of the gas-saturated layer were considered. Effects of vacuum rolling on the structure and content of gases in Mo were investigated. (Rev. Metal Lit.)

23745 CURRENT-CARRYING CAPACITY OF SUPERCONDUCTING Nb_3Sn LAYERS PRODUCED BY AN INTERDIFFUSION HEAT TREATMENT. Silverman, R.; Castleman, L. S.; Tufts, C. F. Trans. Amer. Soc. Metals, 59: 185-93(1966).

Superconducting composite niobium-tin wire was prepared by cold drawing a niobium tube containing a tin core to a thickness of 0.005 in. and generating a Nb_3Sn layer at the niobium-tin interface by means of an interdiffusion heat treatment. The current-carrying capacity of the wire was determined at 4.2°K in an external magnetic field of 11.2 kilogauss as a function of the temperature and time of heat treatment. Superconducting currents of the order of 1 to 2 amp were carried by samples heat treated for as little as 5 to 15 sec at 1000°C. The results supported the suggestion of Buehler that phase interfaces are important to the current-carrying capacity of Nb_3Sn prepared by an interdiffusion treatment in composite niobium-tin wire. (auth)

23746 THE KINETICS OF BETA-PHASE DECOMPOSITION OF NIOBIUM–ZIRCONIUM. Love, G. R.; Picklesimer, M. L. (Oak Ridge National Lab., Tenn.). Trans. Met. Soc. AIME, 236: 430-5(Apr. 1966).

Above 950°C the Nb–Zr system consists of a completely miscible bcc solid solution, commonly called the β-phase. Between 950 and 600°C, and between 20 and 85% Nb, the β-phase decomposes, after sufficiently long times, into two bcc solid solutions. The kinetics of the decomposition in fine-grained Nb–33 at. % Zr alloys are conveniently described with T-T-T (time-temperature-transformation) curves having a nose at about 2 hr at 700°C. The reaction rate varies only slowly with Zr content and negligibly with oxygen contamination; it is speeded up by a factor of 10 to 15 by 90% cold work and slowed down by a factor of 10 to 20 by a two-hundredfold increase in grain size. (auth)

23747 SOME OBSERVATIONS ON THE TEMPERING RESPONSE OF LOW-CARBON URANIUM-BEARING STEEL. Contractor, G. P.; Munro, D. A. (Department of Mines and Technical Surveys, Ottawa). Trans. Met. Soc. AIME, 236: 447-54(Apr. 1966).

Fourteen 50-lb laboratory melts were investigated to determine the effect of uranium on the tempering characteristics of low-carbon (0.06 to 0.1% C) steels. It was found that uranium additions, particularly in the range 0.30 to 0.45%, enhanced the hardness and both ultimate and yield strength of the experimental steels in the

quenched and tempered condition. The structural and morphological changes indicated that uranium retarded tempering of the martensite, thereby hindering the normal formation of polygonal ferrite formed in the late stages of tempering. The effect of this was to make possible the retension of the acicular ferritic structure in the uranium-bearing steels. The uranium-bearing steels also showed Widmanstatten-type growth of ferrite plates and had large prior austenite grains containing assemblies of fine ferrite grains, mainly acicular in geometry. The fine-grained ferrite structure and the presence of more numerous and apparently smaller precipitates in the uranium-bearing steels are thought to be principally responsible for the improved tensile strength and hardness of the experimental uranium-bearing steels. At tempering temperatures above 455°C the ferrite in the higher-uranium steels maintained acicularity and, hence, its strength and resistance to tempering. Uranium did not produce a secondary hardening peak. However, it retarded softening during the third stage of tempering because of its effect of inhibiting the growth of cementite particles and of retaining the acicularity of ferrite plates. The resistance to coalescence accounted for the slow growth of the ferrite grains in the uranium-modified steels and, hence, for the persistence of the acicular ferrite structure. (auth)

23748 SLIP IN TUNGSTEN AT HIGH TEMPERATURES. Taylor, Jack L. (California Inst. of Tech., Pasadena). Trans. Met. Soc. AIME, 236: 464-70(Apr. 1966).

Single crystals of tungsten grown from powder-metallurgy swaged rod by high-temperature annealing were deformed in tension at temperatures from 2500 to 5000°F. Orientation of specimen tensile axis, strained matrix, and deformation bands was determined optically by reflections from {110} etch pits. Slip traces were analyzed and slip direction determined. Results indicate that {110}⟨111⟩, {112}⟨111⟩, and {123}⟨111⟩ type slip occur in tungsten over the temperature range investigated. Slip is orientation-dependent occurring on that combination of slip plane and direction which has the highest critical resolved shear stress. Overshooting appears to be a general occurrence between 2500 and 5000°F. Deformation bands show rotation in a direction opposite to the rotation of the tensile axis. (auth)

23749 PHYSICAL PROPERTIES OF SOME NIOBIUM ALLOYS AT LOW TEMPERATURE. Harris, B.; Peacock, D. E. (Pratt and Whitney Aircraft, North Haven, Conn.). Trans. Met. Soc. AIME, 236: 471-3(Apr. 1966).

Thermal-expansion and electrical-resistivity measurements were carried out below 400°K on Nb and two Nb alloys containing W. For the alloys, Cb-132 (Nb–12.5 at. % Ta–9.1 at. % W–5.7 at. % Mo) and D-43 (Nb–5.3 at. % W–1.1 at. % Zr–0.08 at. % C), it was found that there was an anomaly in the expansion vs temperature curve below about 300°K. This result is consistent with an earlier observation that Young's modulus for Cb-132 has an unusually strong temperature dependence below room temperature. No anomalous behavior was observed in the resistivity vs temperature curve for either alloy or in the magnetic susceptibility vs temperature curve for Cb-132. These results are discussed in terms of various electronic and bonding theories of the transition metals and their alloys, but it has not been possible to reach any definite conclusion as to the cause of the results obtained. (auth)

23750 COMPARISON OF POLE-FIGURE DATA OBTAINED BY X-RAY DIFFRACTION AND MICROHARDNESS MEASUREMENTS ON ZIRCALOY-2. Rittenhouse, P. L.; Picklesimer, M. L. (Oak Ridge National Lab., Tenn.). Trans. Met. Soc. AIME, 236: 496-501(Apr. 1966).

A rapid and semiquantitative method of determining preferred orientation on large numbers of Zircaloy-2 specimens was desired. Knoop microhardness measurements were investigated as a solution to this problem. The variation of Knoop microhardness measurements on selected planes as a function of indenter axis relative to crystallographic or fabrication directions was determined for four lots of polycrystalline Zircaloy-2, on which both conventional and inverse pole figures had been determined, and on seven Zircaloy-2 single crystals. Data from the single crystals were used to construct a polar coordinate hardness contour map. With use of an empirical relation between the single-crystal hardnesses and those of the polycrystalline material conventional pole figures could be constructed which compare favorably with those determined by x-ray diffraction. A quantitative relation with inverse pole-figure data was also obtained. To determine preferred orientation qualitatively from hardness data requires a minimum of twelve measurements per plane on three, preferably orthogonal, planes. The exact procedure requires attention to grain size, specimen preparation, and indenter load. The time required for preparation, measurement, and analysis is of the order of 45 to 60 min. (auth)

23751 KINETICS OF ALLOY FORMATION IN SINTERED TUNGSTEN–RHENIUM POWDER COMPACTS. Smith, Darrell W. (General Electric Co., Cleveland, Ohio); Hehemann, R. F. Trans. Met. Soc. AIME, 236: 506-12(Apr. 1966).

The kinetics of alloying in W–5 wt % Re powder compacts were investigated at temperatures above the upper limit for the formation of the χ-phase, such that a single intermediate phase (σ) was involved in the process. The rates and directions of motion of the α-σ and σ-β interfaces were assessed as functions of time at the sintering temperature by quantitative metallographic techniques. The motion of these interfaces could be specified approximately by a parabolic rate law and deviations from this rate law were attributed to a complex interaction between surface diffusion and volume diffusion during the initial stages of sintering. (auth)

23752 X-RAY INVESTIGATION IN THE NIOBIUM–COBALT SYSTEM. Raman, A. (Univ. of Texas, Austin). Trans. Met. Soc. AIME, 236: 561-5(Apr. 1966).

The Nb–Co system was investigated in the range 10 to 80 at. % Co with x-rays. A μ-phase with the W_6Fe_7-type structure occurs in the system between 46 and 52 at. % Co. Its unit-cell dimensions are nearly identical to those of the μ-phases found in the Nb–Fe and Nb–Ni systems. Two Laves phases, one having the $MgZn_2$-type structure and the other the $MgCu_2$-type structure, already reported in the literature, are found to exist in the system. The $MgZn_2$-type phase occurs between 62 and 64 at. % Co. A $MgNi_2$-type Laves phase, reported in the literature, is not obtained. A binary phase is found to exist below 1000°C around 82 at. % Co. (auth)

23753 CREEP OF THORIATED NICKEL ABOVE AND BELOW 0.5 T_m. Wilcox, B. A.; Clauer, A. H. (Battelle Memorial Inst., Columbus, Ohio). Trans. Met. Soc. AIME, 236: 570-80(Apr. 1966).

The steady-state creep of TD Nickel (Ni + 2 vol % ThO_2) was studied over the temperature range 325 to 1100°C and the stress range 15,000 to 36,000 psi. At high temperatures (above 0.5 T_m) grain-boundary sliding is the most important mode of creep deformation, and the steady-state creep rate, $\dot{\epsilon}_s$, can be related to stress and temperature by: $\dot{\epsilon}_s = A\,\sigma^n \exp -(Q_c/RT)$, where Q_c = 190 kcal per mole and n has an unusually high value of 40. A creep mechanism based on cross slip of dislocations around ThO_2 particles can satisfactorily explain the low-temperature ($T < 0.5\ T_m$) creep behavior, and the following relation is applicable: $\dot{\epsilon}_s = B \exp -[Q_c(\sigma)/RT]$. $Q_c(\sigma)$ is found to decrease from 57 to 46 kcal/mole as the stress is increased from 32,000 to 36,000 psi. (auth)

23754 CORRELATION OF DENSITY OF POROUS TUNGSTEN BILLETS AND ULTRASONIC-WAVE VELOCITY. Smith, J. T.; LoPilato, S. A. (Avco Corp., Wilmington, Del.). Trans. Met. Soc. AIME, 236: 597-8(Apr. 1966).

Porous tungsten matrices were fabricated from the powders by hot pressing in induction-heated graphite die assemblies. The bulk densities were measured by the ASTM water-immersion technique. The ultrasonic-velocity measurement technique employed was through transmission, pulse echo at a frequency of 1.0 Mc. The ultrasonic velocity increased linearly with increasing density, but the rate of increase depended upon the pore geometry, which was a

function of powder shape and size distribution. The larger the particle size, the greater the rate of increase of ultrasonic velocity with increasing density. (W.L.G.)

23755 DIFFUSION OF HYDROGEN IN YTTRIUM. Vorobiov, V. V.; Ryabchikov, L. N. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 11: 209-11(Feb. 1966). (In Ukrainian).

The mass spectrometer was used to determine the diffusion constants of hydrogen in yttrium by the rate of degasation of samples previously saturated with hydrogen. In the temperature range of 470–850°C a formula was obtained for the diffusion constant of hydrogen in yttrium. The quantities of hydrogen retained by yttrium with hydrogen pressures below 5.10^{-4} mm Hg were determined in the same range of temperatures. At a temperature above 850°C yttrium does not retain a perceptible quantity of hydrogen. (auth)

23756 INVESTIGATIONS IN THE SYSTEM BISMUTH–URANIUM–OXYGEN. Ruedorff, Walter; Erfurth, Henning (Univ., Tuebingen, Ger.). Z. Naturforsch., 21b: 85-6(Jan. 1966).

Bismuth oxide Bi_2O_3 reacts with uranium oxide U_3O_8 in air to form the bismuth uranium Bi_2UO_6. This compound crystallizes in hexagonal deformed fluorite lattice. It forms mixed crystals with Bi_2O_3. The lattice structure of the mixed crystals at various concentrations of Bi_2O_3 was determined. The reaction of Bi_2O_3, U_3O_8, and UO_2 in an evacuated quartz ampul led to the formation of $BiUO_4$. $BiUO_4$ crystallizes in the fluorite lattice. UO_2 forms no mixed crystal series with $BiUO_4$, although mixed crystals between $BiUO_4$ and U_4O_9 occur. $BiUO_4$ forms mixed crystals with Bi_2O_3 in a very limited region. (J.S.R.)

23757 DISLOCATIONS IN COLUMBIUM CARBIDES ON THE AREA OF FRACTURE IN CHROMIUM–NICKEL SYSTEMS. Rysava, M. pp 251-2 of Electron Microscop. Prague, Czech. Acad. Sci., 1964.

The area of fracture of austenitic corrosion-resistant Cr18-Ni9 steel was studied by the replica method with fixed particles (carbon films were used). A 15% HCl solution in methyl alcohol was used for the electrolytic dissolution of the alloy base. During the brittle fracture of the Nb–stabilized austenitic steel, niobium carbides in the form of thin plates or films covered by a system of parallel cracks appeared on the area of fracture. A dense dislocation network formed in the metal in the carbide particles during fracture could be seen in an electron microscope. No dislocation network could be seen in the carbide particles from the areas without cracks. (Rev. Metal Lit.)

23758 OBSERVED VARIATIONS IN THE PHYSICAL PROPERTIES OF SOME GRAPHITES. Pyron, C. M. Jr.; Pears, C. D. (Southern Research Inst., Birmingham, Ala.). 44p. (CONF-650632-5). ORINS. Gmelin, AED-CONF-65-149-12.

From 7th Biennial Conference on Carbon, Cleveland.

Variations in several thermal and mechanical properties were examined for a large cylinder of CFZ graphite and several small cylinders of ATJ graphite. Part of the variation is random data scatter resulting from the test methods and the variation in specimens from piece to piece as related to unknown effects such as lattice structure differences. Some of the variations can be correlated with variations in bulk density, macrostructure, and flaw occurrence. The mechanical properties showed a definite correlation with density, but practically no detectable correlation with results of radiographic studies. Variation in the thermal properties with density was small for the observed range of densities. The effects of other parameters such as cracks and inhomogeneities on physical properties are discussed. Suggestions are made for further study to determine the effect of the property variations on design parameters and material requirements. (auth)

23759 MICROSTRUCTURE AND DEPOSITION PROCESS OF PYROLYTIC GRAPHITE. Nagaoki, T.; Tominaga, Y. (Nippon Carbon Co. Ltd., Yokohama, Japan). 19p. (CONF-650632-6). ORINS. Gmelin, AED-CONF-65-149-16.

From 7th Biennial Conference on Carbon, Cleveland.

The orientation functions in the microstructure of pyrolytic graphite from the deposition process are reported. The microstructure was analyzed by x-ray diffraction. The density and orientation of pyrolytic graphite depended on the deposition temperature. The occurrence of minimum density is discussed. The preparation of samples is described. Density measurements were carried out by the sink-float technique, and deposition rates were determined from the thickness of deposits and the time. The orientation functions of three types of pyrolytic graphite obtained from the reflection intensity by x-ray diffraction are shown. A microstructure model of pyrolytic graphite is shown. A model is also presented for the deposition process. An example of the density and deposition rate dependency on the deposition position in the furnace in a run at about 1600°C is shown. (F.J.H.)

Radiation Effects

See also CHEMISTRY — Radiation Chemistry

Refer also to abstract 23472.

23760 (AD–624559) HYBRID COMPUTATION OF TRANSIENT RADIATION EFFECTS ON ELECTRONICS. Final Report. Bell, J. E. (Hughes Aircraft Co., Fullerton, Calif.). Mar. 1, 1965. Contract AF04(694)-565. 46p. CFSTI $2.00 cy, $0.50 mn.

The results of an investigation of the usefulness of hybrid computers in TREE prediction programs are presented. The advantages of analog, digital, and hybrid computers for application to one particular problem are discussed. The results of a hybrid solution of the response of a preamplifier to gamma radiation are presented. (D.C.W.)

23761 (AD–624874) RADIATION-ABSORBING GLASS. Final Research Report, June 27, 1964–October 27, 1965. Fishwick, John H. (Foote Mineral Co., Berwyn, Pa.). Contract DA-36-038-AMC-1729(A). 28p. CFSTI $2.00 cy, $0.50 mn.

The regions of glass formation in the system Li_2O–B_2O_3–PbO–SiO_2 were determined at the levels of 10, 15, and 20 wt % Li_2O. Three compositions were selected at the levels of 10, 30, and 50 wt % PbO as potential glasses for the use in the optical system of a radiation-protected pod. The manufacture of these three glasses is described, and their properties are reported. (TAB)

23762 (AD–624884) INVESTIGATION OF RADIATION-INDUCED SEMICONDUCTOR PROPERTIES IN ORGANIC AND INORGANIC MATERIALS. Final Report, June 15, 1964–June 15, 1965. Andrews, Paul A.; Mayburg, Sumner; Wall, James A. (Controls for Radiation, Inc., Cambridge, Mass.). Contract AF19(628)-4240. 48p. (AFCRL–65-720). CFSTI $2.00 cy, $0.50 mn.

Phenanthrene was purified by zone-refining methods, and the resistivity of the material was determined as a function of temperature. A discontinuity in the resistivity-temperature curve was observed at about 68°C for both compressed polycrystalline pellets and single crystals, and this discontinuity was intensified in the purer portions of the material. Various possible explanations are discussed. Attempts to zone-refine low- and high-density polyethylene resulted in a brittle material which cracked on cooling. No segregation of impurities was observed. Electron irradiation of both silicon and selenium solar cells indicated that silicon cells are more resistant to radiation damage than selenium cells. Carrier removal in silicon appears to be responsible for the radioinduced fluctuation in the base resistance and emitter efficiency of silicon transistors. (TAB)

23763 (AD–625341) STUDY FOR GENERALIZED MODEL FOR SEMICONDUCTOR RADIATION RESPONSE PREDICTION. Quarterly Progress Report No. 2, March 15–June 15, 1965. Raymond, James P.; Chang, William W. (Nortronics, Newbury Park, Calif. Applied Research Dept.). Contract DA-28-043-AMC-00423(E). 72p. (ECOM–00423-2). CFSTI $3.00 cy, $0.75 mn.

Investigations were made of grown-junction diodes and transistors and the transistor element of a monolithic chip integrated circuit. The ionizing radiation response of the diode was calculated using the known values of diode recovery time and junction area. The calculated and observed photocurrents are in agreement within a factor of two. The common-emitter response of the grown-junction transistor was calculated. The open-base and small-signal transistor response was obtained from electrical parameter measurements and the collector photocurrent with a source resistance of zero. Discrepancies between the calculated and observed waveforms are attributed to variations in common-emitter current gain and carrier motion by drift in the collector region. Ionizing radiation effects in an integrated circuit transistor element were studied analytically and experimentally. The lumped model demonstrates the motion of carriers generated in the collector region to the base or substrate regions. The common-emitter response is used to show the influence of the substrate photocurrent on the total observed collector current. Neutron-induced lifetime degradation was directly introduced in the transistor lumped model to give the expected form of transistor gain reduction. The results compare favorably to the Messenger-Spratt prediction. (TAB)

23764 (AD-626474) RADIATION EFFECTS ON DIELECTRIC MATERIALS. Quarterly Report No. 1, June 1–August 31, 1965. Overmyer, R. F.; Nichols, D. K.; van Lint, V. A. J. (General Atomic, San Diego, Calif.). Dec. 17, 1965. Contract DA-28-043-AMC-01412(E). 36p. (GA-6715; ECOM-01312-1). CFSTI $2.00 cy, $0.50 mn.

The characteristics of the irradiation facilities and the instrumentation used in measuring the transient radiation effects in capacitor dielectric materials are described. The Accelerator Pulsed Fast Assembly and the TRIGA reactor irradiations of Mylar, mica, ceramic, and tantalum oxide dielectrics are described with some preliminary results included; however, final results await dosimetry data and computer analysis of delayed conductivity components. An effort to compare capacitor transient effects data from various sources is discussed. Analysis of the data and measurement techniques is being carried out in an attempt to resolve some of the discrepancies in reported data. A program of data comparison between General Atomic and IBM is also discussed. A Linac experiment with several mica capacitors indicated that air trapped inside small, molded-case capacitors may be the explanation for some anomalous transient effects measurements. The numerical estimates of neutron induced conductivity and charge transfer in dielectrics have been improved due to the realization that certain approximations used in the derivation cause a much smaller error than formerly supposed. A program is outlined for verification of the theory using direct irradiation with protons of various energies. (auth)

23765 (ANL-7176, pp 86-93) NUCLEAR SAFETY. (Argonne National Lab., Ill.).

Research on the development of UO_2 fuel pins is discussed. A meltdown experiment consisting of Zircaloy-2 clad UO_2 fuel pins was performed and the resulting reactions with the water coolant were investigated. (M.O.W.)

23766 (BNL-9169) MICROSCOPIC OBSERVATIONS OF FISSION-FRAGMENT TRACKS IN SOLIDS. Goland, Allen N. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT(30-2)-Gen-16. 67p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The current understanding of the formation of fission-fragment tracks in solids as influenced mainly by electron microscopic studies is reviewed. The predictions of radiation-damage theories are compared with experimental observations and certain conclusions are drawn about the permanent effects of fission fragment interactions with various kinds of solids. (M.O.W.)

23767 (BNWL-88) EFFECTS OF FAST NEUTRON IRRADIATION, FABRICATION HISTORY, AND WATER OXYGEN ON THE ENVIRONMENTAL BEHAVIOR OF ZIRCONIUM ALLOYS. Burns, W. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1965. Contract AT(45-1)-1830. 88p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The corrosion program included the Zr alloys: Zircaloy-2, Zircaloy-4, Ni-free Zircaloy-2, and Zr–3 wt % Nb–1 wt % Sn. In addition to the fast neutron irradiations, the effects of heat treatment, preirradiation, coolant irradiation alone, anisotropy of texture, heavy cold work, and hydrogen addition to the water environment on the corrosion of the Zr alloys were measured. Exposure data were obtained on over 350 specimens and included time to 264 days, neutron flux intensities from 2×10^{12} to 1×10^{14} nv (>1 Mev), integrated fast neutron exposure to 1.9×10^{21} nvt, and variations in water oxygen content from ~1 ppM to <0.1 ppM. The following tentative conclusions were drawn from the experimental results. Oxygen content of the water environment has a marked influence on in-reactor corrosion rates. Corrosion rates are significantly higher in high-oxygen water than in low-oxygen water. Posttransition oxidation rates in-reactor in high-oxygen water correspond with pretransition rates in low-oxygen water. The fast-neutron component of reactor radiation is primarily responsible for the acceleration of corrosion. Oxidation rates are more sensitive to fast flux magnitude in the thin-film region. Acceleration effects of fast flux on oxidation are more pronounced above 10^{13} nv, and a practical threshold level near 10^{11} is probable. Oxygen–hydrogen content of the water environment influences in-reactor sorption of corrosion hydrogen. Hydrogen pickup fractions are higher in low-oxygen water than in high-oxygen water. Hydrogen pickup fraction is not influenced by changes in the fast flux above the threshold for oxidation effects. Hydrogen pickup fraction is influenced by film thickness. It increases with increasing film thickness in high-oxygen water. It decreases with increasing film thickness in low-oxygen water. Heat treatment and texture effects are important variables in in-reactor corrosion behavior. For any of the alloys tested there is no indisputable evidence for direct pickup of hydrogen from the water environment. At low magnification, the physical appearance of the surface and cross sections of oxide films formed in-reactor are similar to those of films formed in the absence of radiation. Electron microscopy has disclosed a markedly higher population of microcracks in cross sections of in-reactor formed oxide as compared with unirradiated oxide. (W.L.G.)

23768 (BNWL-190) THE EFFECTS OF IRRADIATION AND ENVIRONMENT ON THE MECHANICAL PROPERTIES OF INCONEL–ZIRCALOY TRANSITION JOINTS. Irvin, J. E.; Claudson, T. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1966. Contract AT(45-1)-1830. 40p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Transition joints between Inconel 600 and Zircaloy-2 were irradiated at 550°F to integrated exposures of 6.2×10^{20} nvt (>1 Mev). The integrity of these joints is not impaired by exposures under conditions typical of the BONUS Reactor. Tensile tests at 550°F and room temperature indicate the life of the transition joints will probably be limited by the Zircaloy-2 portion of the tube. A large decrease in ductility was observed after irradiation in the Zircaloy-2 portion of one type of transition joint. Hydrogen pickup was greatest in this particular joint, and is believed to be partially responsible for the marked loss in ductility. Hydride gradients were observed near the transition joints. The mechanical property changes and hydrogen pickup are definitely influenced by the prior fabrication history of these transition tubes. (auth)

23769 (BNWL-202) IMPROVED POSTIRRADIATION TENSILE PROPERTIES OF HASTELLOY X-280. Levy, I. S.; Wheeler, K. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1966. Contract AT(45-1)-1830. 22p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Tensile specimens of Hastelloy X-280, a solution-hardenable nickel-base alloy, were given various experimental preirradiation thermal and/or mechanical

treatments. They were subsequently irradiated at 540°F to exposures of approximately 1×10^{20} nvt (E ≥ 1 Mev) and then tensile tested at room temperature and 1350°F in air. When compared with a standard commercial treatment, the experimental treatment generally showed reduced radiation damage. Some treatments increased postirradiation high temperature ductility by 100% while maintaining strength. One treatment resulted in 100% increase in postirradiation high temperature yield strength with only 2 to 4% ductility loss. Also, a maximum increase of 57% in postirradiation room temperature yield strength was possible while maintaining 18% uniform elongation. Possible mechanisms for the property improvement are set forth; these are based on the character of the interaction of the microstructures, formed by the preirradiation treatments, with neutron irradiation. (auth)

23770 (BNWL-SA-604) DESIGN AND FABRICATION OF A LIQUID METAL TEMPERATURE-CONTROLLED IRRADIATION CAPSULE. Claudson, T. T. (Battelle-Northwest, Richland Wash. Pacific Northwest Lab.). Mar. 10, 1966. Contract AT(45-1)-1830. 35p. (CONF-660511-1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From International Symposium on Capsule Irradiation Experiments, Pleasanton, Calif.

The capsule design can be divided into three portions. The inner portion contains a specimen chamber and a vacuum insulation layer. The next layer is an annulus through which the liquid metal coolant can flow, and the third portion can be considered as the capsule inner and outer containment walls and the temperature control gas annulus between these walls. The capsule utilizes convective flow and was fabricated from type 304 stainless steel. (W.L.G.)

23771 (GEAP-5100E) HIGH-PERFORMANCE UO_2 PROGRAM. IRRADIATION OF 0.5-INCH DIAMETER, HOLLOW PELLET UO_2 FUEL RODS AT 1,400,000 BTU/H-FT^2 PEAK HEAT FLUX. EPT-12C ASSEMBLY. Lyons, M. F.; Nelson, R. C.; Pashos, T. J.; Wilson, C. R.; Weidenbaum, B. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan. 1966. Contract AT(04-3)-189. 309p. (EURAEC-1590). Dep. mn. CFSTI $7.00 cy, $1.75 mn.

Work Performed Under United States-Euratom Joint Research and Development Program.

The fabrication data, irradiation history, and the complete, correlated postirradiation examination results are described for a four-rod fuel assembly—designated EPT-12C that operated in the GETR-PWL with gross central melting to a burnup of 5300 Mwd/te, through two complete reactor cycles and 23 full power cycles. The fuel rods were unsegmented, reactor-length rods containing 95% dense, hollow sintered UO_2 pellets in freestanding Zircaloy-2 cladding. The irradiation and subsequent postirradiation examination of this assembly provided experimental verification that the use of hollow fuel pellets (equal to about 8% internal free volume) will completely eliminate clad swelling resulting from the UO_2 phase change volume expansion during melting. The earlier, solid pellet fuel assemblies exhibited severe clad swelling after operation at slightly lower thermal performance. The immediately preceding hollow pellet fuel assembly contained only about 3% internal free volume, but showed drastically reduced clad swelling after operation at a thermal performance level equivalent to the solid pellet irradiations. However, some slight clad swelling did remain and operation was only for a single reactor cycle and a few full power cycles. The EPT-12C assembly irradiation effectively demonstrated the feasibility of operation with gross central melting to substantial burnups. Following an interim, nondestructive examination at the 5300 Mwd/te burnup level, the EPT-12C assembly was returned to the loop for continued irradiation—tentatively to the 10,000 Mwd/te burnup level. A fuel rod failure occurred on this next startup and both the failed rod, rod 12D, and the maximum power rod, rod 12A, showed moderate clad swelling. The reason for the swelling and failure is believed to have been too rapid a reactor power rise following a substantial alteration of the axial power profile from that existing during the preceding shutdown. Irradiation of rods 12A and 12D was terminated at this time and both rods were subsequently destructively examined. Further irradiation of the two remaining unswollen rods from the EPT-12C assembly, rods 12B and 12C, was attempted in two later assemblies, but unsuccessfully. Both of these rods experienced pinhole clad failures during startup, or shortly after, with no significant additional burnup. Although a common genesis for all the fuel rod failures from the EPT-12C assembly is almost inescapable, no detailed explanation or even hypothesis was obtained for the relation of the pinhole failures to the startup incident and/or the failures involving clad swelling. (auth)

23772 (N-65-13446) EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES. Quarterly Progress Report No. 15, July-September 1964. Schwanbeck, C. A. (Lockheed Nuclear Products, Marietta, Ga.). Contract NASw-114. 45p. (NASA-CR-59928; ER-7604). CFSTI $2.00 cy, $0.50 mn.

Thirty smooth and twenty-two notched tensile specimens were irradiated at 30°R. The specimens consisted of Rene 41, K Monel, Inconel, Inconel X (precipitation hardened), A-286 steel, AM 350 Steel, and 440C stainless steel. Factors studied included: ultimate tensile strength, tensile yield strength, elongation, reduction of area, and fracture stress. The results obtained from nonirradiated and from irradiated specimens were compared. A significant irradiation-induced embrittlement was observable in AM 350 steel, and a measurable reduction in tensile strength was observed in 440C steel as a result of irradiation. (STAR)

23773 (NAA-SR-11140) IRRADIATION BEHAVIOR OF URANIUM MONOCARBIDE FUEL EXPERIMENTS NAA 81-3 AND AI 3-12. Arnold, J. L. (Atomics International, Canoga Park, Calif.). Mar. 25, 1966. Contract AT-11-1-GEN-8. 53p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

Two UC fuel capsules were successfully irradiated to peak burnups of 10,400 and 17,800 Mwd/MtU at temperatures in the 1400 to 1800°F range. The fuel used in these experiments was 0.49-in. dia, as-cast hypostoichiometric UC, with the exception of a 4-in. column of slightly hyperstoichiometric fuel slugs in the lower burnup capsule. The total length of fuel in each fuel rod was 18 in. The fuel was sodium bonded to 0.010-in. thick type 304 stainless steel cladding. The lower burnup capsule (NAA 81-3) was irradiated in the Materials Test Reactor (MTR) for a total of 3126 hr at power. The fuel from this experiment was stable and sound, with the exception of the two fuel slugs which were hyperstoichiometric UC; these slugs had experienced some gross macrocracking. The fuel had a very low fission gas release (0.24% of that theoretically produced) and low fuel growth (1.7 to 2.8% density decrease). The C content of the two hyperstoichiometric fuel slugs had been reduced to essentially the stoichiometric composition for UC. The higher burnup capsule (AI 3-12) was irradiated in the General Electric Test Reactor (GETR), utilizing a Radially Adjustable Facility Tube (RAFT) for a total of 6265 hr at power. The fuel was broken and cracked over much of the length of the fuel rod, with the worst cracking (appearance of coarse gravel) occurring in the two slugs which had in-fuel thermocouple holes along their axial centerlines. The rest of the fuel was broken into pieces, ~1 in. in length. The fuel growth again was low, with density decreases ranging from 3.5 to 7.2%. A definite correlation between fuel composition and fuel growth was found; in that, by increasing the C content, the irradiation stability was increased. Examination of the cladding showed that there had been no fuel-cladding reaction, except for some slight carburization. Even the fuel rod which had the hyperstoichiometric UC did not show extensive carburization of the type 304 stainless steel cladding. The cladding in both fuel rods performed successfully as a containment for fission gas during operation. However, the fission gas from the AI 3-12

fuel rod was lost during disassembly, due to the fracture of a Nicrobraze joint between the in-fuel thermocouple and the top end cap. (auth)

23774 (ORNL–3913, pp 75-109) GAS-COOLED REACTORS. (Oak Ridge National Lab., Tenn.).

Results of investigations on diffusion processes are reported along with those on reactions of reactor components with oxidizing gases and irradiation behavior of high-temperature fuels. Studies of fission-gas release from UO_2 are reported along with miscellaneous studies on solid-fueled reactors. (J.R.D.)

23775 (ORNL–P–1194) IRRADIATION OF SINTERED BERYLLIUM OXIDE TO HIGH FAST-NEUTRON DOSES AT 110, 650, AND 1100 DEG C. Keilholtz, G. W.; Lee, J. E. Jr.; Moore, R. E. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 27p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The behavior of sintered BeO exposed to fast-neutron doses up to 8×10^{21} neutrons cm^{-2} was investigated at 110, 650, and 1100°C with the objective of establishing its limits of stability and mechanisms of damage under conditions to which it would be exposed if used as a moderator in nuclear power reactors. The data are generally consistent with the hypothesis that grain boundary separation, the primary mode of damage to BeO compacts at all three temperatures, is caused by anisotropic crystal expansion, which results from the production of point defects and the agglomeration of defects in the crystal lattice. At 1100°C, a temperature at which in-pile annealing substantially reduces crystal expansion, the data indicate that grain boundary separation is promoted by thermal cycling. To minimize damage in nuclear reactor operation, BeO of small grain size and low density should be used, the temperature should be as high as practicable, and thermal cycling should be avoided. (auth)

23776 (RHEL/R–107) SOME TESTS ON CIRCULAR DIAPHRAGMS OF POLYETHYLENE TEREPHTHALATE FILM. Moore, D. R.; Mortimer, A. R. (National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.). Aug. 1965. 40p. Dep. mn. BIS $1.40. HMSO 7s.

Bursting pressures and deflections of diaphragms made from biaxially oriented polyethylene terephthalate film were investigated in the unirradiated and irradiated states. Creep and permeability were determined and a suitable clamping method was developed. The life of the film under irradiation was estimated. (auth)

23777 (TRG-Report–1161) APPLICATION OF STEREO ELECTRON METALLOGRAPHY TO DETERMINATION OF CRYSTAL ORIENTATION. Haines, R. M. (Reactor Group, United Kingdom Atomic Energy Authority, Sellafield, (England)). Dec. 16, 1965. 11p. Dep. BIS $0.50. HMSO 2s. 6d.

The angular relation between the crystallographic faces of grain boundary holes, formed at elevated temperature in an irradiated material (beryllium) during slow strain to rupture, were measured stereoscopically on electron micrographs. The results show that the orientation of the holes, and thus of the adjacent matrix, can be determined to better than 5°. They also confirm that the holes themselves are practically equiaxed. The method suggests itself as a possible way of measuring grain boundary orientations and relative surface energy relation for other materials after suitable treatment to induce cavitation, provided that their low-temperature fracture characteristics are suitable for revealing the grain boundary holes. (auth)

23778 (WAPD-TM–455) HISTORY OF THE NRX REACTOR X-1-q AND X-3-n TESTS AND THE NONDESTRUCTIVE POST-IRRADIATION EXAMINATION OF THEIR PLATE-TYPE CERAMIC FUEL ELEMENTS. Meieran, H. B. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar. 1966. Contract AT(11-1)-Gen-14. 156p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

A series of plate-type ceramic fuel elements were irradiated in the NRX Reactor X-1 and X-3 loops to investigate the effects of bulk fuel density, fuel temperature, fissioning rate, and the addition of trivalent and quadrivalent metals on the irradiation behavior of certain ceramic fuel materials. Different thermal conditions were obtained by varying the thickness, composition, and density of the ceramic fuel material, and by performing the irradiations in different pressurized water loop environmental conditions. By carefully controlling the loop environmental conditions and by periodic nondestructive interim examination of the test specimens, the behavior of the elements could be followed closely, and irradiation terminated when test criteria were satisfied or exceeded. Examination of the nondestructive data revealed the relative thermal differences in performance between those elements irradiated at 1500 psi and those at 2000 psi pressurized water, the thermal performance limits of plate-type ceramic fuel elements, the enhanced lifetimes resulting from lower power outputs, and the relation between thickness and volume swelling. The mode of irradiation induced volume swelling previously postulated for plate-type ceramic fuel elements was verified in this test series. (auth)

23779 STUDY OF NEUTRON IRRADIATION DAMAGE IN IRON BY ELECTRON-TRANSMISSION MICROSCOPY. Bryner, J. S. (Brookhaven National Lab., Upton, N. Y.). Acta Met., 14: 323-36(Mar. 1966). (BNL–8832).

Bulk specimens of annealed irons containing 0.001 and 0.003 wt. % C were examined by electron-transmission microscopy before and after fast-neutron (E > 1.45 Mev) irradiation at 30–90°C to integrated fluxes in the range, 2×10^{18} to 2×10^{20} nvt, and after post-irradiation heating at 250–600°C. Irradiation produced no detectable changes in the structure of the 0.003 wt. % C iron. Irradiation to 2×10^{20} nvt produced dark spots in the 0.001 wt. % C iron. Post-irradiation heating at 300°C or higher caused formation of spots in the 0.003 wt. % C iron irradiated to 1×10^{19} nvt or higher. Heating at 350°C or higher caused the spots in both irons to grow and form dislocation loops. With increasing time at temperature, the total loop area increased to a maximum and then decreased. Loop growth is ascribed to migration and aggregation of a radiation defect consisting of carbon atoms or other interstitial atoms strongly bound to Frenkel defects and having an activation of diffusion of approximately 39,000 cal/mole. Loop shrinkage is ascribed to migration of these defects to sinks at which the defects are annihilated. Evidence of interaction between moving dislocations and the defects before and after aggregation into visible structures by heat treatment indicated that the defects are capable of affecting the mechanical properties. However, variations in the concentration of loop-forming defects with integrated flux and concentration of interstitial impurities were not consistent with the corresponding variations in the increase in yield stress produced by the irradiations. (auth)

23780 CLUSTERING IN Al–Cu 4 PERCENT ALLOY AFTER NEUTRON IRRADIATION AT -195 DEG C. Pieragostini, F. (Societa Ricerche Impianti Nucleari, Saluggia, Italy); Ceresara, S.; Federighi, T. Acta Met., 14: 450-2 (Mar. 1966).

The results of a preliminary resistometric investigation on the effects of neutron irradiation at –195°C in Al–Cu 4% alloy are reported. Although it was found that the irradiation enhances the rate of clustering in Al–Cu 4% alloys, the amount of clustering after irradiation was small when compared with the effects of the quenching from 500°C. Reasons for this and the lack of zone formation at the beginning of stage III (–110 to 0°C) are discussed. (P.C.H.)

23781 ANNEALING EXPERIMENTS ON REACTOR IRRADIATED p-TYPE GERMANIUM. II. INFRARED ABSORPTION STUDIES. Eldros, Ralf (Chalmers Univ. of Tech., Goteborg). Ark. Fys., 28: 447-59(1965).

The effects of high-temperature reactor irradiation and subsequent annealing were studied for a series of high-purity germanium samples. The absorption coefficients obtained for the irradiated samples before and after annealing at successively higher temperatures are plotted. Isochronal annealing was performed to a maximum tem-

perature of 500°C. Further recovery was not obtained for higher annealing temperatures. (J.F.P.)

23782 LARGE INTERSTITIAL LOOPS IN GRAPHITE CONTAINING BORON. Mayer, R. M. (Univ. of Cambridge, Eng.). Brit. J. Appl. Phys., 17: 431-2(Mar. 1966).

When graphite single crystals irradiated to 4.1×10^{19} neutrons/cm^2 at 50–100°C are doped with boron at 1450°C and then annealed at temperatures greater than 2100°C, large interstitial loops are observed. These are not observed in crystals into which boron had not been deliberately introduced. (auth)

23783 ACTION OF RADIATION ON GLASSES. Le Clerc, P. Bull. Inform. Sci. Tech. (Paris), No. 98, 7-51 (Nov. 1965). (In French).

Glass is shown to be very sensitive to the action of radiation. The radiation produces, by ionization, in transparent vitreous products, visible changes in the optical absorption. The formation of color centers under the influence of gamma and x rays was studied. Work was also carried out on the movement of atoms caused by particle bombardment and the resulting modifications in the physical properties. The main work on the action of radiation on glasses and applications that may be found for the changes produced are reviewed. (auth)

23784 LATTICE PARAMETER CHANGES IN IRRADIATED GRAPHITE. Henson, R. W.; Reynolds, W. N. (Atomic Energy Research Establishment, Harwell, Eng.). Carbon, 3: 277-87(Dec. 1965). (AERE-R-4954).

Changes in the x-ray lattice parameters of Grade A graphite were studied in detail during isothermal irradiations to high doses in the temperature range from 200 to 350°C. The results were analyzed in the light of the crystalline elastic constants. The changes were related to the corresponding changes in overall dimensions and of Young's modulus and the rate of accumulation of stored energy. The estimated energy of formation of a vacancy increased from a previous value of 5.5 ± 1 ev to 7.3 ± 1 ev and the activation energy for its motion within a basal plane was greater than 2.5 ev. The basal plane contraction per vacancy was in reasonable agreement with recent theoretical estimates and unnucleated interstitial atoms appeared to occupy 2 to 4 atomic volumes. (auth)

23785 ELECTRON SPIN RESONANCE IN NEUTRON-IRRADIATED AND IN DOPED POLYCRYSTALLINE GRAPHITE. I. Mrozowski, S. (State Univ. of New York, Buffalo). Carbon, 3: 305-20(Dec. 1965).

The electron spin resonance of neutron-irradiated and lamellar-compound-doped, incompletely graphitized, P33 carbon black was investigated. An improved temperature arrangement operating from room temperature down to liquid nitrogen was constructed. It is shown that the intensity vs temperature curves for P33 can be split into a sum of contributions of localized spin centers and conduction carriers; the irradiation produces mainly localized spins and the doping changing only the carrier concentration. The two kinds of spin centers interact by exchange so that they produce a single line with a g-value intermediate between that for localized spin centers g_{free} and for the conduction carriers g_c. The g-value can be calculated using a simple mix formula, each type of spin contributing in proportion to its absorption intensity. The g_c value for conduction carriers varies according to irradiation dose or amount of doping and is always lower than the directionally averaged graphite value due to a combined effect of displacement of the Fermi level and of the spreading apart of the layers, both causing a change in spin-orbit interaction. Extensive studies of variation in ESR parameters with irradiation dose, amount of doping (Li, Na, K, Rb, H_2SO_4, and ammonia), temperature of annealing and ambient temperature permitted the transition of the Fermi level across the center of the band overlap (with Na and Li) to be observed. (auth)

23786 X-RAY INVESTIGATION OF RADIATION DEFECTS IN BERYLLIUM OXIDE. Konobeevskii, S. T.; Klimenkov, V. I.; Kosenkov, V. M. Dokl. Akad. Nauk SSSR, 165: 524-5(Nov. 21, 1965). (In Russian).

Samples of sintered BeO were irradiated with an integrated flux of 2×10^{21} fast neutrons at a temperature less than 100°C. As a result of irradiation the samples disintegrated into powder. The size of the powder particles formed by irradiation was found to be equal to the grain size of the unirradiated samples (~100 μ). Each powder particle was a monocrystal. The diffraction lines of unirradiated samples showed an undistorted structure. Irradiation resulted in broadening of the diffraction lines and a decrease in the line intensity. At all angles $2\theta > 95°$ no diffraction peaks could be discerned from the background. The broadening of the peaks was sharply anisotropic. The width of the line (010) was practically unaltered, while the line (002) was broadened 3.5 times. The degree of broadening of the other lines depended on the angle between the diffraction and the base planes. Anisotropic broadening was also observed in the powder patterns, indicating that anisotropy can probably be attributed to internal distortions of the BeO lattice. The broadening of the line (002) on exposure to an integrated flux of 2×10^{20} fast neutrons/cm^2 and greater was very complex. Simultaneously with an anisotropic broadening of the line, an anisotropy in the increase of the lattice constant exposed to irradiation was noted. The Laue pattern of a powder particle ($70 \times 60 \times 100$ μ) formed by irradiation showed two series of spots: the normal pattern and a series of broadened spots. The origin of the latter could not be adequately explained. The experimental data are interpreted as indicating that irradiation with nvt = 2×10^{20} fast neutrons/cm^2 produced single defects which upon further exposure formed clusters causing the distortion of the crystal lattice of BeO. (CFSTI)

23787 THE STUDY OF ADHESION OF POLYETHYLENE COATINGS ON ALUMINUM BASES DURING IRRADIATION. Kabanov, V. Ya.; Grozinskaya, Z. P.; Zubov, P. I.; Spitsyn, Vikt. I. (Inst. of Physical Chemistry, Academy of Sciences, SSSR). Dokl. Akad. Nauk SSSR, 165: 626-8(Nov. 21, 1965). (In Russian).

An investigation was made on adhesion on samples subjected to a beam of accelerated electrons. Samples were prepared from nonstabilized low-pressure polyethylene deposited by melting on 50μ-thick aluminum foil supports. The heating lasted 10 min at 230°C with a subsequent application of 6 kg/cm^2 of pressure. The independence of adhesion of dose intensity indicated that the Al–O–R and Al–R chemical bonds play no significant role. Analysis of the data indicated that the basic assumptions of the electrical theory of adhesion cannot be used for the explanation of the influence of irradiation on adhesion between polyethylene and aluminum foils. (CFSTI)

23788 GENERATION OF VACANCIES IN KBr,Sr IRRADIATED WITH A PROTON BEAM. Melik-Gaykazyan, I. Ya.; Lisitsyn, V. M. (Tomsk Polytechnic Inst., USSR). Fiz. Tverd. Tela, 7: 1994-6(1965).

An investigation was made of the accumulation of F-centers in KBr crystals irradiated with protons accelerated up to 6 Mev in a cyclotron so that an experimental determination could be made of the influence of Sr impurity on the radiative generation of vacancies. The concentration of F-centers was determined by the absorption of light in the maximum of the F-band. The parameters for the Mitchel-Froelich kinetic equation were determined on the basis of the accumulation of F-centers. The rate of generation of F-centers on radiative vacancies (a*) depends on the rate of generation of vacancies (a), on the capture of electrons by those vacancies (c), and on radiative decay (β) $a^* = ac/c + \beta$. The generation rate of F-centers in KBr · Sr crystals was greater than in pure crystals. However, this does not mean that the impurity increases the rate of generation of vacancies (a), because when an impurity is introduced into a crystal the radiative decay (β) decreases. Calculation results for single crystals of KBr and KBr + 0.023 mole % $SrCl_2$ at two different irradiation intensities showed that Sr impurities can increase the rate of radiative generation of anion vacancies by several times. (CFSTI)

23789 UNIAXIAL ANISOTROPY INDUCED BY A LOW-TEMPERATURE MAGNETIC ANNEAL FOLLOWING

ELECTRON IRRADIATION. Sery, R. S.; Gordon, D. I. (U. S. Naval Ordnance Lab., Silver Spring, Md.). J. Appl. Phys., 37: 1216-17(Mar. 1, 1966).

It was shown previously that an electron radiomagnetic treatment (electron irradiation in the presence of an applied magnetic field) can bring about a high degree of uniaxial anisotropy in low H_c nickel-iron alloys. A number of samples so treated at temperatures of 105°C ± 30°C attained high B_r, μ_{max}, and rectangularity with only small changes in H_c. The new data show that the same properties can be achieved by an alternative process: irradiation with or without an applied field at 65°C ± 25°C, followed by a low-temperature (<200°C) magnetic anneal of ≈1 h. Polycrystalline samples of Mumetal and 5-80 Mo-Permalloy, subjected initially to 0.8 to 1.1×10^{17} 2-Mev-electrons/cm^2 with a 0.22-Oe field and in the range of 40 to 90°C did not generally exhibit the high B_r and μ_{max} of those treated at the higher temperatures. However, subsequent isochronal anneals (one hour per anneal in steps of 25 or 50°C and from 100 to 500°C) in a 0.22-Oe field did bring about high rectangularity and high values of B_r and μ_{max}. For example, in a typical sample, B_r and μ_{max} increased by 30 and 82%, respectively. Improvements in properties started at <100°C for Mumetal. These results emphasize three important factors in the production of radio-induced magnetic anisotropy: irradiation, the mechanism for producing excess vacancies; temperature, the condition which permits a high enough diffusion rate to enable the orientation to occur within a reasonable time; and applied field, the orienting agent for alignment of like-atom pairs to produce uniaxial anisotropy. The results also show that the irradiation phase need not be simultaneous with the orienting phase nor need it have an applied field present. (auth)

23790 EFFECT OF NEUTRON IRRADIATION ON CATALYSTS FOR THE ORTHO-PARAHYDROGEN REACTION. Leffler, Amos J. (Villanova Univ., Pa.); Ostar, Bruce. J. Catalysis, 5: 74-80(Feb. 1966).

The effects of neutron preirradiation on alumina coated with boric oxide or sodium tetraborate and transition metal oxides were examined as a function of the method of catalyst preparation, hydrogen pressure, and flow rates. In the preparation of the catalyst systems, boron was added in the form of boric oxide or sodium tetraborate in order to produce the (n,α) reaction and thus induce lattice damage. It was found that neutron irradiation of chromium and nickel oxides, coated on boron-containing alumina, increased their ability to catalyze the para- to ortho-hydrogen conversion at 77°K in the case of poor catalysts, but either did not appreciably alter or decrease the activity of good catalysts. It was also found that the activity of irradiated catalysts decreased with the passage of hydrogen through the material. The result can be explained by assuming that neutron activation induces defect structures which exhibit paramagnetism; if the number of induced sites is large enough compared with the number of active sites available, then an increase in activity will be noted. When the number of induced sites is small or when the defects tend to destroy the activity of sites already present, then radiation will decrease the activity of a catalyst or at least cause little change. The radiation-activated sites are deactivated (probably by hydrogen adsorption) more easily than unirradiated sites. (BBB)

23791 THE EFFECT OF IRRADIATION ON STRESS RELAXATION IN NIMONIC 80A. Taylor, R.; Jeffs, A. T. (Reactor Materials Lab., Culcheth, Eng.). J. Nucl. Mater., 10: 142-8(May 1966).

Springs of Nimonic 80A were irradiated with fast neutrons under constant strain conditions at temperatures in the range 325 to 525°C. It is observed that much larger stress relaxations occur under irradiation than in equivalent thermal tests. The results are compared with creep and relaxation theories and it is found that relaxations can be described by a derivative of Nutting's equation. The mechanism is believed to be one of dislocation climb by the absorption of irradiation-induced vacancies. (auth)

23792 BINDING OF INERT GAS BUBBLES TO PRECIPITATES. Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 10: 149-54(May 1966). (AERE-R-5060).

The equilibrium configuration of inert gas bubbles attached to precipitates was discussed. It is shown that the energy gained on attachment in enveloping the interface is exactly equal and opposite to that necessary to create the new equilibrium surface area. The binding energy between the two therefore depends only on the work done by the gas on expansion to its new equilibrium volume. The retaining force of precipitates is compared with various bubble driving forces expected to occur in nuclear fuels in an attempt to evaluate the effectiveness of precipitates in controlling swelling and gas release by restricting the motion of bubbles. It is concluded that the precipitate must have a high interfacial tension in order to give adequate control at high burnup. (auth)

23793 OBSERVATION OF THIN LAYERS OF URANIUM-MOLYBDENUM ALLOYS FROM IRRADIATED FUEL ELEMENT. Colombe, G.; Azam, N.; Lehmann, J. (CEN, Saclay, France). J. Nucl. Mater., 18: 66-9(Jan. 1966). (In French).

The thin layer technique was used to study uranium–molybdenum alloys irradiated in the reactor for periods from 3 months to 3 years and cooled for a period of one to two years after discharge. The experimental techniques and conditions used for following the evolution of the structure of the strongly irradiated materials is described. Typical examples of the results obtained are shown. The results showed the irradiation of uranium–molybdenum alloys in the temperature range from 300 to 450°C lead first of all to the distortion of the γ lamellae caused by the growth of pseudo-α grain. Above an irradiation rate of 2500 Mwd/t all lamellar morphology had disappeared and the material has a new structural state. The mechanisms leading to this state have not been defined. (J.S.R.)

23794 EFFECTS OF NUCLEAR RADIATION AND CRYOGENIC TEMPERATURES ON NONMETALLIC ENGINEERING MATERIALS. McKannan, E. C.; Gause, R. L. (Marshall Space Flight Center, Huntsville, Ala.). J. Spacecraft Rockets, 2: 558-64(July-Aug. 1965).

Engineering data on the changes produced in the physical properties of nonmetallic materials by exposure to the various combinations of cryogenic temperatures, nuclear radiation, and vacuum are being sought. To date, ~80 materials from the following functional categories were evaluated in one or more of these combinations of environments: structural adhesives, structural laminates, thermal insulations, electrical insulations, potting compounds, seals, sealants, lubricants, and thermal control coatings. The effects of cryogenic temperature and radiation on some of these materials are discussed. The materials examined are representative of those most likely to be used on spacecraft employing nuclear power systems. Although many of the materials were stable at the combined environmental conditions employed in the tests, a few unpredicted results were observed. Epoxy-Nylon adhesive lost strength at cryogenic temperatures. Glass-to-resin bonds in plastic-glass laminates broke because of differential thermal expansion at cryogenic temperatures, thereby increasing the apparent elongation. Plastic foams from stable polymers had poor radiation resistance, a condition that seemed to be a function of the foaming process. Polystyrene and polyurethane resins showed low radiation resistance when expanded into a foam. It is suggested that this effect is dependent on the foaming agent. A fluorocarbon resin which had poor radiation resistance in air and LH_2 had exceptionally good resistance in LN_2. An explanation of these differences is based on reactions with the medium rather than on temperature. (BBB)

23795 RADIATION-INDUCED GRAFT COPOLYMERIZATION TO POLYVINYL CHLORIDE. III. HEAT SHRINKAGE OF ACRYLONITRILE GRAFTED POLYVINYL CHLORIDE FIBER. Okada, Toshio; Sakurada, Ichiro. Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 6: 57-65 (1964-1965). (In Japanese).

Graft copolymerization of acrylonitrile to polyvinyl chloride fiber in a stretched state was carried out by

means of mutual grafting technique with γ rays, and the heat shrinkage of the grafted fibers were measured. The heat shrinkage of the polyvinyl chloride fiber to which acrylonitrile was grafted to the extent of about 50% at 60°C decreased compared with the original fiber. It was further found that the heat shrinkage was markedly decreased when the grafted fibers were subjected to heat treatment at 160 to 180°C. (auth)

23796 MECHANICAL ANALYSIS FOR SOLID CYLINDRICAL FUEL ELEMENTS OF NUCLEAR REACTORS. Ma, Benjamin M. (Iowa State Univ., Ames). Nucl. Eng. Design, 3: 11-20(Jan. 1966).

A theoretical, mechanical analysis for strain and stress distributions in long, solid cylindrical fuel elements of nuclear reactors is presented. In the analysis primary effects of thermal-cycling growth, irradiation growth, swelling, creep and neutron flux levels developed in the fuel material are taken into account. The equations for the components of strain and stress are derived from some basic assumptions. From the results of an illustrative example the order of magnitude of neutron flux, degree of irradiation, thickness, or properties of the cladding are found to have important effects on strain and stress distributions produced in the fuel elements. (auth)

23797 SATURATION BEHAVIOR OF THE DEFECT PRODUCTION IN ELECTRON-IRRADIATED COPPER BELOW 7.5 DEG K. Dworschak, F.; Neuhaeuser, J.; Schuster, H.; Wurm, J.; Potyka, S.; Sokolowski, G.; Wollenberger, H. (Institut fuer Reaktorwerkstoffe der Kernforschungsanlage, Julich, Ger. Technische Hochschule, Aachen). Phys. Rev. Lett., 16: 685-7(Apr. 18, 1966).

An experiment is described for examining the saturation behavior of the defect production in copper irradiated with 3-Mev electrons at temperatures below 7.5°K. The change of the residual electric resistivity with integrated electron flux was measured. (B.G.D.)

23798 USE OF IRRADIATION TO IMPROVE GLASS-REINFORCED PLASTICS. Kiselev, B. A.; Egorova, Z. S.; Karpov, V. L.; Bodrova, V. V.; Porokhov, V. S. Plast. Massy, No. 7, 35-8(1965).

The feasibility of substituting α irradiation for heat treatment in order to improve the mechanical properties of very thick glass-reinforced plastics (GRP) was studied. GRP based on the following binders were irradiated with small doses (up to 100 Mrad): EF-32-301 (epoxy-phenol type), FN (phenol-furfural-formaldehyde type), VFT-S (phenol-formaldehyde + polyvinyl butyral + an organosilicon monomer [unspecified]), and SK-9E (epoxy + an organosilicon monomer). The effect of the α-irradiation on various mechanical and physical properties whose improvement is desirable, such as tensile strength, modulus of elasticity, and, in some cases, softening point was determined. It was found that irradiation with small doses improved the physical and mechanical properties of GRP based on binders containing double bonds or epoxy groups. On the other hand, such irradiation impaired the properties of GRP based on modified phenol-formaldehyde and organosilicon binders which contain no double bonds or epoxy groups. (CFSTI)

23799 EFFECT OF GAMMA RADIATION ON THERMOMECHANICAL PROPERTIES OF POLYAMIDE FILMS. Afanas'ev, A. M.; Pavlov, S. A. Plast. Massy, No. 7, 39-43(1965).

Changes occurring in polyamide films under the influence of integral radiation doses up to 500 mrad during heating from 25 to 300°C were studied by a thermomechanical method. Mixed polyamides of type AK 50/50, S-6, and ultramide-1S were chosen for the study. The films were prepared from ethanol solutions under near-industrial conditions, subjected to ^{60}Co γ radiation, and then deformed. The deformation curves were plotted after exposure to 50, 100, 200, and 500 mrad. Starting at about 100 mrad, the irradiated films did not melt at the melting point of the original samples; their deformability in the high-temperature range (150–300°C) became limited and decreased with increasing dose. The properties of the irradiated films thus depend not only on the structure of the polymer and the integral dose, but also to a considerable extent on the conditions of formation of the films and characteristics of the original structure. By using the optimum conditions of film formation, the desired properties can be obtained (e.g., high thermal stability) in the irradiated materials or articles for a smaller expenditure of radiation energy. (CFSTI)

23800 STRUCTURAL MODIFICATION OF NICKEL OXIDE IRRADIATED BY NEUTRONS. I. EXPERIMENTAL RESULTS. Benes, Liudmila; Stoica, Ludmila (Institut de Physique Atomique, Bucharest). Rev. Roum. Phys., 10: 823-8(1965). (In French).

The structure of nickel oxide irradiated by fast neutrons was studied by x-ray diffraction. Structural modifications were observed in samples exposed to a neutron flux of 3 $(10)^{18}$/cm^2. The effect can be established only for the (111) and (200) lines. Each of these lines from the irradiated and from the nonirradiated samples is shown. (J.F.P.)

23801 THE EFFECT OF NITROGEN ON THE RADIATION EMBRITTLEMENT OF IRON. Colombo, R. L.; Rossi, F. S.; Sebille, J. (Fiat, Turin. Centro Ricerche Nucleari, Saluggia, Italy). Solid State Commun., 4: 55-8 (Jan. 1966).

Two vacuum-melted pure iron alloys, the former containing a maximum of free nitrogen and the latter enough titanium to block the remaining nitrogen and carbon in nitride and carbide form, were carefully prepared in an induction furnace. From these materials, sub-size Charpy-notched specimens were machined and then irradiated to an integrated fast neutron flux of about 1.4×10^{19}n/cm^2 (>1 Mev) and in some cases annealed for 28 hr at 200°C. Notch-impact tests at different temperatures revealed that in the iron-titanium alloy the ductile-brittle transition temperature is raised by about 60°C by irradiation, while in the iron-nitrogen alloy the increase was about 160°. (auth)

23802 EFFECT OF NEUTRON IRRADIATION ON CRYSTALLINE VITREOUS MATERIALS. Brekhovskikh, S. M.; Grinshtein, Yu. L. Steklo Keram., No. 8, 15-17 (1965).

Crystalline samples of sitals (pyroceramics) S-343, S-1214, Zh-3, and IV-23 were sealed in aluminum containers and exposed to fluxes of 10^{16}, 10^{18}, and 10^{19} thermal neutrons/cm^2 in a reactor. The temperature of the reactor cavity remained below 40°C. The irradiated samples were tested for density, hardness, and dielectric properties. The opaque white sitals turned various shades of grey and brown on irradiation; the intensity of coloration increased with irradiation. The transparent sital S-343 turned blue with complete loss of transparency at 10^{18} neutrons/cm^2. Except for sital IV-23, whose density increased at 10^{18} neutrons/cm^2, no noticeable changes in density were observed. The microhardness of the majority of the sitals changed only some 10–15%. Significant changes in microhardness took place in boron-containing sital IV-23 on irradiation. The nature of changes in dielectric properties of the sitals investigated differed, depending on the irradiation dose (measurements were taken at 10^5, 10^6, and 10^7 cps). While the sense of the change remained the same at all frequencies, the magnitude of the changes at higher frequencies decreased; sital IV-23 showed a high degree of stability. Unlike sital S-343, sital IV-23 retained the induced changes in microhardness, even on annealing above 500°C. This indicates the irreversible nature of the changes. Most of the radioinduced changes in IV-23 were localized in the surface layer. (TCO)

23803 STUDY OF THE DIFFUSION AND PRECIPITATION OF RARE GASES IN METALS. Levy, Viviane; Gerl, M.; Perraillon, B.; Adda, Y. (Centre d'Etudes Nucleaires, Saclay, France). pp 115-32 of STI-PUB-109(Vol.2). (In French).

The theoretical study of swelling is highly complex and calls for accurate knowledge of several parameters: the mobility of the rare gases and of the vacancies in the metal lattice, and the mechanisms of bubble generation and growth.

Measurements of the diffusion coefficients of rare gases in metals, performed either on irradiated materials or on models in which the rare gas was introduced by electric discharge, showed that precipitation of the rare gas during thermal diffusion treatment interferes considerably with the measurements, producing values of D which are either too high or too low. Using models, the different factors affecting the generation and growth of bubbles: temperature, gas concentration, number and distribution of crystal defects were studied. The study was carried out by transmission electron microscopy on neutron-irradiated Al–^{6}Li alloys. Precise measurements of the diffusion coefficients of ^{133}Xe in irradiated U were made in respect of radiation rates giving rise to very low gas contents. The results show that there is a discontinuity in the diffusion coefficient as the U passes from the β-phase to the γ-phase; this manifests itself as a reduction in D and an increase in the activation energy of the phenomenon from 23 kcal/atom for the β-phase to 98 kcal/atom for the γ-phase. Various interpretations of the phenomenon in relation to the mechanisms of rare gas diffusion are considered. (auth)

23804 EFFECTS OF GAMMA AND ULTRAVIOLET IRRADIATION ON SOME COMMERICAL BOROSILICATE GLASSES. PART 4. STRESS IN GLASS CAUSED BY ULTRAVIOLET IRRADIATION. Ooka, Kazuo; Kishii, Toru (Tokyo Shibaura Electric Co., Kawasaki, Japan). Yogyo Kyokai Shi, 73: No. 8, 163-9(1965). (In Japanese).

Six kinds of commercial glasses were irradiated by ^{60}Co gamma rays with total dose of 7×10^{7} R. In spite of distinct blackening, density change was not recognized. Thermoluminescence was intense in fused silica, while not recognized in lead glasses. Outer protection bulb (soda borosilicate glass) of a mercury discharge lamp damaged by ultraviolet irradiation showed stress at inner surface and coloring, and by heat bleaching, thermoluminescence and release of space charge took place. This proved that the damage was not a result of thermal effect such as overheating. Two kinds of commercial borosilicate glasses were irradiated by 400 w mercury discharge lamp for two weeks or by ^{60}Co gamma rays with total dose of 5×10^{7} R. In the former case, though coloring and thermoluminescence were slight or unrecognized, stress build-up at irradiated surfaces was observed. In the later case, distinct blackening and thermoluminescence were observed. Interaction between ultraviolet rays and glass and related problems are discussed. Temperature ranges in which various thermal release phenomena took place were compared. It was concluded that contraction (density increase) of glass by ultraviolet irradiation is not directly related to electronic phenomena. However, this is still an open question. (P.C.H.)

23805 RADIATION-INDUCED CONDUCTIVITY IN RUTILE. Compton, D. M. J.; Cheney, G. T.; Gehman, B. L. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). 17p. (CONF-650707–18; GA–5381). ORINS.

From IEEE Annual Conference on Nuclear and Space Radiation Effects, Ann Arbor, Mich.

The conductivity produced in rutile single crystals at 300°K by short (10-nsec to 5-μsec) pulses of 30-Mev electrons showed simple behavior, which was ohmic and proportional to dose rate. It can be explained on a simple model involving recombination controlled lifetime without trapping. Quantitatively similar results were obtained using d-c and microwave measuring techniques. Similar measurements on ZnO showed both a transient and permanent increase in electrical conductivity. (auth)

PHYSICS

General

23806 (AED-C-23-08(Pt.1)) HIGH-ENERGY PHYSICS. Series C: Bibliographies. Mellentin, K.; Vierk, I. (comps.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Gmelin-Institut fuer Anorganische Chemie und Grenzgebiete, Frankfurt am Main (West Germany)). Aug. 1965. 266p. Dep. mn.

Approximately 4,000 articles dealing with all aspects of high-energy physics are listed. Author and report number indexes are included. (M.O.W.)

23807 (AED-C-23-08(Pt.2)) HIGH-ENERGY PHYSICS. Series C: Bibliographies. Mellentin, K.; Vierk, I. (comps.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Gmelin-Institut fuer Anorganische Chemie und Grenzgebiete, Frankfurt am Main (West Germany)). Aug. 1965. 284p. Dep. mn.

23808 (NIRS-4, pp 3-12) PHYSICAL SCIENCES: PHYSICS. (National Inst. of Radiological Sciences, Chiba (Japan)).

Progress is reported in studies on cesium metabolism in man following the administration of ^{132}Cs; the determination of the optimum window setting in a spectrometer for low level activity counting; the development of a versatile time-of-flight neutron spectrometer; an investigation of the dose distributions produced by implanted sources of Ra, ^{198}Au, ^{192}Ir, ^{182}Ta, ^{137}Cs, and ^{60}Co; measurements of neutron flux distribution in concrete; estimations of the x radiation dose received by bone marrow during diagnostic radiography; the development of a thermoluminescent dosimeter with charge sensitive amplifier; measurements of the angular distribution of high energy scattered x radiation and bremsstrahlung in a water phantom irradiated by an electron beam and x rays of 15 to 29 Mev energy; and the neutron production rate and neutron flux distributions of cosmic ray produced neutrons on the ground. (C.H.)

23809 (TID-22735) QUARTERLY PROGRESS REPORT NO. 80. Zimmermann, H. J.; Harvey, G. G. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Jan. 15, 1966. Contracts AT(30-1)-3581; AT(30-1)-3285; AT(30-1)-1842. 276p. (RLE-QPR-80). Dep. mn. CFSTI $6.00 cy, $1.50 mn.

The efforts of groups engaged in research on general physics, plasma dynamics, and communication sciences and engineering are described. Abstracts were prepared only for research reported on plasma dynamics. Separate abstracts were prepared for five of six sections grouped under plasma dynamics. The section for which no abstract was prepared is concerned with interactions of laser radiation with plasma. (J.R.D.)

For abstracts of individual sections see: 23997, 24185, and 24513–24515.

23810 INELASTIC SCATTERING OF A WAVE PACKET. Bunchaft, F.; Chaves, C. M.; Baltensperger, W. (Centro Latino-Americano de Fisica, e Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). An. Acad. Brasil. Cienc., 37: 39-47(1965). (In Spanish).

A system described by time-dependent correlations between its particles scatters incident radiation inelastically. It is shown, however, that in the scattering of a wave packet components with different energies do not interfere. This is true for any order of perturbation as a consequence of homogeneity in time of the correlations. Spatial homogeneity inhibits all interference effects. An inhomogeneous or infinite target permits interferences between components of the wave packet with the same energy but with different directions. In general, the angular distribution of the scattered particles determines the instantaneous spatial correlations only just as in the case of plane waves. (auth)

23811 ANALYSIS OF EXPERIMENTAL DATA CHARACTERIZED BY $x^m dx$ DISTRIBUTIONS. Roinishvili, N. N.; Mandritskaya, K. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1784-7(Sept. 1965). (In Russian).

The determination of the exponent m in a distribution of the type $x^m dx$ from experimental data is considered. The method of least squares for estimating m and the chi-square criterion for comparing hypothetical values of m are very laborious for a power law distribution and they do not give optimum results. The maximum likelihood estimate of m and the likelihood ratio criterion for comparing hypothetical values of m are presented, and their advantages are pointed out. In order to normalize the distribution the range of the independent variable x is restricted to the interval (0, 1). The likelihood function then becomes a very simple function of the average of the logarithms of the sample (experimental) values, and the probability distribution for the likelihood ratio becomes an incomplete gamma function, tables of which are readily available. The maximum likelihood estimate for the power law distribution is simple to compute and efficient. The bias of the maximum likelihood estimate is pointed out and removed. The applications of the methods discussed are illustrated. (ATD)

23812 PRESSURE WAVES PRODUCED BY THE NUCLEAR EXPLOSIONS IN 1952–1958. Murayama, N. Kishocho Kenkyu Jiho, 17: 105-14(Feb. 1965). (In Japanese).

All microbarographic records in Japan of pressure waves produced by nuclear explosions at the various locations up to the present, particularly those in 1952–1958, were reexamined and listed in the table. Propagation velocity of the waves was recalculated from the explosion data released recently. Pressure wave records of July 2, 1956, which might be caused by a nuclear testing (no announcement elsewhere), of June 28, 1958 by the U.S.' largest nuclear explosion, and of August 12, 1962 by the near-stratopausal explosion, are presented. (auth)

23813 PENETRATION OF A STRONG PULSED MAGNETIC FIELD INTO A THIN-WALLED CYLINDER HEATED BY AN INDUCTION CURRENT. Shneerson, G. A. Zh. Tekh. Fiz., 35: 2234-9(Dec. 1965). (In Russian).

The penetration into the interior of an infinitely long thin-walled metallic cylinder of a uniform axial magnetic field suddenly created outside is calculated with the nonlinear effects arising from the change in the resistivity of the cylinder wall owing to heating by the induced current taken into account. For the calculation it is assumed that the resistivity of the metal is a linear function of the heat content per unit volume, and heat exchange with the surroundings is neglected. The nonlinear integrodifferential equation for the current is integrated once directly and the resulting equation is solved by separation of variables. The rise of the field within the cylinder is characterized by the value of the ratio B_e/B_0' of the external magnetic field strength B_e to the critical field strength $B_0' = (4h\,\mu_0/r\beta)^{1/2}$, where h is the wall thickness, r is the radius of the cylinder, μ_0 is the permeability of the vacuum, and β is the derivative of the resistivity with respect to the heat content per unit volume. For copper, aluminum, and iron cylinders with $h/r = 0.05$, the critical field B_0' is 42, 32, and 47 Wb/m^2, respectively. The times required for the internal field to reach half its final value when the ratio B_e/B_0' is 0, 1, 2, or 3 are in the ratio 1 : 0.68 : 0.39 : 0.26. (ATD)

23814 THE ENCYCLOPEDIA OF PHYSICS. Besancon, Robert M. (ed.). New York, Reinhold Publishing Corp., 1966. 843p. $25.00.

The aim of the book is to provide in one volume concise and accurate information on physics. Introductory articles on physics, its history, measurements, and nomenclature

and general articles on the major areas of physics are provided. Subdivisions of the major areas are covered by more detailed and more technically advanced entries than the broad general articles. Topics involving combinations of physics and other disciplines are included. The technical level of the articles varies, the level of each entry being aimed at the readers most apt to look for information on that topic. References to summary articles and books and cross references to other articles within the encyclopedia are provided. A subject index is included. The book is of use to physicists needing information outside of their areas of interest, to teachers and librarians, to students, and to engineers and scientists. (M.J.T.)

23815 LECTURES IN THEORETICAL PHYSICS. VOLUME VII C. STATISTICAL PHYSICS, WEAK INTERACTIONS, FIELD THEORY. Lectures Delivered at the Summer Institute for Theoretical Physics, Univ. of Colorado, Boulder, 1964. Brittin, Wesley E. (ed.). Boulder, Colo., Univ. of Colorado Press, 1965. 493p.

Separate abstracts were prepared for each of the nine papers included. (G.O.Y.)

For abstracts of individual papers see: 23816, 23989, 24072, 24073, 24158, and 24199–24202.

23816 HEURISTIC APPROACH TO SOME TYPICAL MANY-BODY PROBLEMS. Carmi, Gideon (Yeshiva Univ., New York). pp 269-344 of Lectures in Theoretical Physics. Vol. VII C. Boulder, Colo., Univ. of Colorado Press, 1965.

It is shown that many major concepts such as collective modes, long-range correlations, symmetry breaking, stable equilibrium regions in phase space, and phase transitions can be quite naturally associated with the behavior of a simple system composed of two equal masses in one dimension connected by an ideal spring. The electron gas and superconductors are considered in some detail. (D.C.W.)

Accelerators

Refer also to abstracts 24355 and 24500.

23817 (AD–624271) BEAM INSTABILITIES IN THE PRINCETON–STANFORD STORAGE RINGS. Barber, W. C. (Stanford Univ., Calif. High-Energy Physics Lab.). Sept. 1965. Contract Nonr-225(67). 21p. (HEPL–406). CFSTI $1.00 cy, $0.50 mn.

The most salient features of the beam instabilities in the Princeton-Stanford storage rings are summarized. The phenomena are classified into three groups: vertical instabilities of a single beam; vertical instabilities associated with the interaction between two beams; and changes in radial and azimuthal size of single beam. (TAB)

23818 (AD–627324) [PARTICLE ACCELERATORS.] Final Report, February 1, 1956–July 31, 1964. Wilson, Robert R. (Cornell Univ., Ithaca, N. Y. Lab. of Nuclear Studies). Contract Nonr-401(26). 25p. CFSTI $1.00 cy, $0.50 mn.

The synchrotron was modified to increase the operating energy from 1.3 Bev to a design energy of 2.2 Bev. At the same time a proposal was generated for the design and construction of a 10 Bev electron synchrotron. The modification of the 1.3 Bev synchrotron was conceived in July 1962, and the major design features were completed by April 1963. Construction progressed during the last half of 1963, and on January 20, 1964, the 1.3 Bev machine was turned off and assembly and modification was begun. A beam was first obtained in the modified machine on April 28, 1964, just a little over three months after tear-down and assembly were begun. The next month was used in making final modifications and adjustments. (TAB)

23819 (AD–627351) MODIFICATION PROGRAM FOR THE NEVIS SYNCHROCYCLOTRON. Rainwater, James (Nevis Labs., Columbia Univ., Irvington-on-Hudson, N. Y.). Jan. 1966. Contract Nonr-266(72). 161p. (R–536; NEVIS–144). CFSTI $5.00 cy, $1.00 mn.

The plan envisages an eventual conversion to 500 to 600-Mev proton kinetic energy and > or = 10 microamp time average current. It is hoped to obtain a high extraction efficiency which will permit a 10 to 50 microamp time average external proton beam current having a high duty factor, with corresponding high intensity pion and muon beams. This program will involve a major building and shielding, etc., extension. It is planned to use spiral ridge iron shims with <B (r) > (average over azimuth) increasing with r more slowly than for isochronism, but by an amount which will give a greatly reduced r-f frequency swing. This should permit a repetition rate of about 300/sec. The design study will rely strongly on the use of one-fifth scale cyclotron model magnet for field studies. Using a vacuum system, ion source, frequency modulated r-f system, etc., it will also be used for central region studies using spiral ridge iron shimming. This model operating FM cyclotron may also be used for a partial investigation of extraction modes where the protons would emerge along a high spiral angle valley field contour. (auth)

23820 (ANL–7139) EXPERIMENTAL SHIELDING STUDY OF THE ARGONNE 12.5-Mev TANDEM VAN DE GRAAFF INSTALLATION. Dyer, N. C.; Mundis, R. L. (Argonne National Lab., Ill.). Jan. 1966. Contract W-31-109-eng-38. 9p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The radiation hazards associated with operation of the 12.5-Mev tandem Van de Graaff Accelerator at Argonne National Laboratory were determined experimentally. The operating conditions of the accelerator during this study were such as would produce the greatest possible radiation hazards. The levels of penetrating radiation, both gamma and neutron, were measured outside the shield walls. With few exceptions, the radiation levels outside the shielding were far below 2.5 mRem/hr, which is the average level that would result in an exposure equal to the radiation protection guide of 5 Rem/year. In areas adjacent to the accelerator that normally are occupied by personnel, such as the control room and data rooms, the radiation levels never exceeded 0.02 mRem/hr. A brief description of the Tandem Van de Graaff installation is given. (auth)

23821 (CERN–66-12) CONSIDERATIONS ON THE USE OF THE CERN STORAGE RINGS FOR ELECTRON-PROTON COLLISIONS. Goldzahl, L.; Michaelis, E. G. (European Organization for Nuclear Research, Geneva (Switzerland)). Mar. 16, 1966. 16p. Dep. mn.

The results of a preliminary analysis of the possibility of using the CERN storage rings for electron-proton collisions are presented. (D.C.W.)

23822 (LNF–65/50) IL SISTEMA DI RADIO FREQUENZA DEL MICROTRONE. (Radiofrequency System of the Microtron. Note No. 301). Bizzarri, U.; Vignati, A. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Dec. 28. 1965. 8p. Dep. mn.

A microtron model with a maximum energy of 4.5 Mev and a pulse current intensity of 0.5 mamp was developed at Frascati National Laboratory. The technical problems encountered and resolved in the dimensioning of the r-f system and of the resonance cavity of the microtron are described. The r-f system is described. The principal defects of the system consists of the cold emission and fluctuation in intensity with consequent fluctuations in the intensity of the accelerated beam. The introduction of an injector thermocathode will increase by a factor of 50 the intensity of the machine and improve the stability. (J.S.R.)

23823 (TID–22594) REPORT ON INVESTIGATION OF EXPLOSION AND FIRE, EXPERIMENTAL HALL, CAMBRIDGE ELECTRON ACCELERATOR, CAMBRIDGE, MASSACHUSETTS, JULY 5, 1965. (Cambridge Electron Accelerator, Mass.). Feb. 1966. Contract AT(30-1)-2076. 89p. GPO $0.60.

An explosion and fire occurred at the Cambridge Electron Accelerator at 3:32 a.m. on July 5, 1965, resulting

in the injury of 8 persons working in the Experimental Hall and the subsequent death of one of them. The cause of the explosion was not immediately determined but a large quantity of liquid hydrogen and liquefied petroleum gas had been present in the building. Damage to the structure and equipment was estimated at about $1,500,000. Results are reported from an investigation of the explosion and fire. (C.H.)

23824 (SLAC-Trans-29) PHASE INSTABILITY OF INTENSE ELECTRON BEAMS IN STORAGE RINGS. Auslander, V. L.; Karliner, M. M.; Naumov, A. A.; Popov, S. G.; Skrinskii, A. N.; Shekhtman, I. A. Translated by T. Watt (Stanford Linear Accelerator Center, Stanford Univ., Calif.), from Paper Presented at 5th International Conference on High Energy Accelerators, Frascati, Italy, Sept. 9-16, 1965. 38p. (CONF-650923-28). Dep. mn. CFSTI $2.00 cy, $0.50 mn. JCL $3.60 fs, $1.34 mf.

Radial phase self-oscillations which appear in storage rings at high beam currents are discussed. Stability conditions are derived for an arbitrary frequency characteristic of the accelerating system. Allowance is made for the interaction of the beam with the accelerating system and other elements of the vacuum chamber at frequencies which are harmonics of the orbital frequency of the particle bunch. The influence of the spread in the synchrotron frequencies of individual electrons is discussed. Results are reported of an experimental study of self-excited phase oscillations in the storage systems at the Nuclear Physics Institute in Novosibirsk. A number of methods for suppressing phase instability are put forward and examined. (auth)

23825 (SLAC-Trans-34) START-UP OF THE B-ZM SYNCHROTRON, AN INJECTOR FOR A POSITRON-ELECTRON STORAGE RING. Budker, G. I.; Kiselev, A. E.; Kon'kov, N. G.; Naumov, A. A.; Nifontov, V. I.; Ostreiko, G. N.; Panasyuk, V. S.; Petrov, V. V.; Yudin, L. I.; Yasnov, G. I. Translated by T. Watt for Stanford Linear Accelerator Center, Stanford Univ., Calif., from a Paper Read at the Fifth International Conference on High-Energy Accelerators, Frascati, Italy. 20p. (CONF-650923-27). Dep. mn. CFSTI $1.00 cy, $0.50 mn. JCL $1.60 fs, $0.80 mf.

The construction and operation of the B-ZM synchrotron, which acts as an injector for a positron-electron storage ring, are described. At the present time, the synchrotron operates at E = 100 to 130 Mev and the current of accelerated electrons is up to 100 ma (1.6×10^{10} electrons per pulse). (auth)

23826 ELECTRON BEAMS ARE EXTRACTED FROM THE INS 750 Mev AG ELECTRON SYNCHROTRON. Tomiie, Kazuo (Tokyo Univ.); Kawasaki, Sumao. Genshikaku Kenkyu, 10: 468-87(Dec. 1965). (In Japanese).

Electron beams were extracted from the INS 750-Mev alternating gradient electron synchrotron by a piccioni scheme. The extraction efficiency was about 10% at an electron energy of 540 Mev and 5% at 700 Mev. (auth)

23827 SPACE CHARGE DE-BUNCHING IN CHARGE-PARTICLE BEAMS. Inman, Fred W. (Univ. of the Pacific, Stockton, Calif.); Muray, J. J. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 1-9 (Apr. 1966).

One of the factors influencing the properties of a pulsed beam is the growth of the charge bunches due to space charge forces. The growth along the direction of motion of the bunch degrades the time structure of the pulsed beam and the growth traverse to the direction of motion defocuses the beam. Although the space charge effect is only important at high current densities, it must be considered a limiting factor in any pulsed beam system. A general method of obtaining the field in the bunch to second order in v/c was developed. From this the motion of charges in the bunch was obtained by numerical integration for the case of a Gaussian distribution of space charge under the assumption that the charge distribution remains Gaussian. Solutions are presented in a dimensionless, graphical form which can easily be scaled for a particular problem. (auth)

23828 DEVELOPMENT OF A FREQUENCY AGILE RF ACCELERATING SYSTEM FOR THE ZERO GRADIENT SYNCHROTRON. Winje, R. A. (Argonne National Lab., Ill.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 25-31(Apr. 1966).

A conceptual design for the r-f system for the proposed ZGS modification will be presented. The system differs very little, in principle, from the present ZGS r-f system. The primary engineering difference lies in the extended power output capacity of the amplifier. The parameters and characteristics of the accelerator are outlined and the electronic equipment in an r-f system meeting those needs is described. The radiation environment of the amplifier and cavity will be discussed and methods preventing failure of the system suggested. (auth)

23829 HIGH STABILITY VOLTAGE PROGRAMMED RF SOURCE FOR THE ZERO GRADIENT SYNCHROTRON. Dinkel, John A. (Argonne National Lab., Ill.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 32-7(Apr. 1966).

An oscillator is described which generates a frequency program which sweeps between 4-13.7 MHz with an initial df/dt of 172 MHz/sec and a final df/dt of 420 kHz/sec. This program is stable within 0.025% of the required value. F-M noise on the order of 800 cps peak-to-peak appears on the first part of the program and reduces to less than 250 cps p-p near the end. A second r-f output is provided which sweeps 1 MHz above the 4-14 output to be used with beam monitoring equipment employing a 1 MHz heterodyne technique. Both r-f outputs employ automatic gain control loops to maintain 2vpp across 125Ω. (auth)

23830 ELECTRONIC CIRCUITS FOR THE ARGONNE NATIONAL LABORATORY'S PION-FOCUSING HORN. Vogel, H. F.; Johanson, E. W.; Lewis, R. N. (Argonne National Lab., Ill.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-13: 74-8(Apr. 1966).

The electrical characteristics of the ANL pion-focusing horn, the capacitor discharging and charging circuits, and the control circuits are discussed. (B.G.D.)

23831 THE DACCA VAN DE GRAAFF. Hossain, Anwar; Hussain, Emdad; Hussain, Muhtasham. Nucl. Sci. Appl., 1: 13-38(Dec. 1965).

A description of the 3 Mev Van de Graaff accelerator at Dacca, Pakistan is presented. The associated experimental facilities including the building and shielding, liquid air plant, gas transferral system, vacuum arrangement, and cooling water system are described. The theory of operation of a Van de Graaff positive ion accelerator is discussed. The energy calibration procedure is included. (B.G.D.)

23832 PROPOSAL OF A METHOD FOR THE IMPROVEMENT OF THE ENERGY HOMOGENEITY OF PARTICLE BEAMS FROM LOW-ENERGY ACCELERATORS AND FOR A TRANSMISSION TIME SPECTROMETER OF HIGH RESOLUTION. Kalus, Juergen; Maier-Leibnitz, Heinz; Vonach, Herbert (Technische Hochschule, Munich). Nukleonik, 8: 68-73(Feb. 1966). (In German).

A system of electric and magnetic fields was proposed by which the energy in homogeneity of a beam emitted by an accelerator can be improved and the accurate energy of the beam finally obtained was no longer determined by the accelerator but by the phase difference between two high voltages. The construction of the apparatus on a transmission time spectrometer of high resolution was discussed. (tr-auth)

23833 THE EXTERNAL ELECTRON BEAM OF THE FRASCATI ELECTRON SYNCHROTRON. Bizzarri, U.; Conte, M.; Quercia, I. F.; Turrin, A. (CNEN, Rome). Nuovo Cimento (10), 42A: 639-48(Apr. 1, 1966).

The beam extraction from the Frascati electron synchrotron was accomplished by exciting the $\nu_r = 2/3$ nonlinear betatron resonance. The second harmonic pattern of the sextu-

polar perturbation in the guiding field that is required to bring the radial oscillations into resonance is introduced by pulsing currents into few wires of the pole face windings of the four quadrants, connected in a loop. In this way the beam is brought into a two-magnet with septum deflecting channel and escapes completely from the magnetic field. The extraction channel is described; the preliminary characteristics of the external beam, the results of measurements on the extraction efficiency and the spill-out times obtained are presented. (auth)

23834 PROPOSAL FOR A NEW HIGH-INTENSITY MICROTRON. Luccio, A. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan). Nuovo Cimento (10), 42B: 376-7(Apr. 11, 1966).

A modified high-intensity microtron with a spiral-like trajectory is proposed, which might overcome some of the difficulties that limit the maximum current in the conventional microtron. The main features are briefly discussed. (L.B.S.)

23835 NEGATIVE H ION ACCELERATION IN THE U-120 CYCLOTRON. Indreas, Gr.; Tauth, Th. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 877-83(1965).

H^- ions were accelerated in the U-120 cyclotron. For this purpose a common proton arc source was used and an averaged beam intensity at the final radius of acceleration of ~5 μamp was obtained. Under these conditions, the influence of source parameters on the accelerated beam intensity was studied. It is noted that the acceleration process has the same behavior as that for protons, except for the pregnant H^- ion beam intensity dependence on the residual gas pressure. (auth)

23836 HEAVY ION ACCELERATION IN THE U-120 CYCLOTRON WORKING IN MULTIPLE FREQUENCY STATE. Indreas, Gr.; Tauth, Th. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 885-92 (1965).

The heavy ion acceleration for multiple frequencies at the U-120 cyclotron was studied. The production of ions was made with the help of a usual arc discharge proton source. On the final accelerating radius, a beam intensity of 50 μamp for C- and N-doubly ionized ions and of 5–10 μamp for O, C, and N triply ionized ions was obtained. For the C_{12}^{+2} ions the deflection of the beam was also performed with a 10% efficacy. (auth)

23837 SOME FORMULAS FOR ANALYZING THE IONIC LOCUS OF A CYCLOTRON OUTER LEAD SYSTEM. Fang, Shou-hsien. Yuan Tzu Neng, No. 2, 122-9(1965).

In connection with the study of the outer lead system of the 1.2-meter cyclotron of the Chung-kuo k'o hsueh yuan Yuan tzu neng yen chiu so (Atomic Energy Research Institute, Chinese Academy of Sciences), some formulas are derived for analyzing the ionic locus of this system. It is taken for granted that the deflection plate is so placed that the electric field is perpendicular to the ionic locus. If electric field intensity is E (in volt/cm), and the ratio of ionic velocity to the velocity of light is β, then the corresponding magnetic intensity is $E/300\beta$. The deflection of the cyclotron is divided into three parts: the plane electrode, with position angle 40°; the double-curve electrode, with position angle 60°; and the outer lead from deflection plate to vacuum casing. Applying the formulas derived, the process is found simpler, more convenient, and more accurate than other existing methods. The result obtained in calculating the ionic locus by means of these formulas varies not more than 2 mm from that obtained by existing methods. Ionic mobility is then considered in the case when the initial state of the ions deviates from the basic locus. Formulas are derived for calculating the ionic mobility. (ATD)

23838 PHASE SHIFT DURING PARTICLE ACCELERATION IN A CYCLOTRON. Fang, Shou-hsien. Yuan Tzu Neng, No. 2, 156-8(1965).

In a frequency modulated cyclotron, although the conflict between synchronizing the alternating field and focusing has been solved, a focusing problem still remains near the central region. In this area, divergent focusing will cause energy losses from the accelerating particle. An optimum curve that could be found to reduce the area of divergent focusing was indicated previously; this result, however, should be compensated in some degree by synchronization. In order to maintain a low phase shift, the voltage on "dees" must not fall below a certain value. The optimum spiral curve and the phase shift were calculated and compared with an Archimedes spiral. It was found that the minimum voltage is 40% less than that of the Archimedes spiral. (ATD)

23839 SOLVING EQUATIONS OF MOTION FOR TRAVELING-WAVE ELECTRON ACCELERATORS. Zhileiko, G. I. (Moscow Power Engineering Inst.). Zh. Tekh. Fiz., 35: 2239-42(Dec. 1965). (In Russian).

The equations of motion of electrons in a traveling wave accelerator are written with the ratio $u_s = U_s/U_0$ of the equilibrium kinetic energy U_s to the rest energy U_0 as independent variable in place of the longitudinal coordinate z. These equations include the effects of space charge and radiation of the bunched electrons. Advantages of writing the equations in this form are pointed out. These include ease of calculating the acceptance angle, the simple manner in which the coordinate z can be introduced after the equations have been solved, and the fact that the space charge and radiation fields are explicit functions of u_s rather than of z. Certain approximations that are suggested by the form of the equations and certain limiting cases, including that of negligible beam current, are discussed briefly. (ATD)

23840 APPROXIMATE CALCULATION OF THE EFFICIENCY OF A μ-MESON CHANNEL. Abrosimov, N. K.; Nikolaeva, V. A.; Sherman, S. G. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 35: 2248-9(Dec. 1965). (In Russian).

A previously proposed method for estimating the efficiency of a magnetic quadrupole lens muon duct is discussed. This method involves evaluation of a triple integral. Here it is pointed out that the muon capture efficiency, which is a periodic function of z, is actually nearly independent of z when the pion momentum is high (z is presumably a coordinate measured along the duct), and that by assuming this quantity to be independent of z the triple integral can be reduced to a double integral. If the pion momentum scatter is small the triple integral can be further reduced to a single integral. The muon efficiencies of three ducts of different design were calculated as functions of the pion momentum and the results are presented graphically. The muon efficiency passes through a maximum at a certain pion momentum. The maximum muon efficiency increases and the pion momentum at which the maximum efficiency is reached decreases with increasing values of the ratio l/d, where l and d are two lengths that are presumably defined. (ATD)

23841 METHOD FOR CONSTRUCTING AN ACCELERATING TUBE. Iwashita, Fumio (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-10280. May 25, 1965. Filed Aug. 22, 1963.

An accelerating tube for a linear accelerator is constructed of a number of discs and short cylindrical bodies made of a metal such as oxygen-free copper. The discs and cylindrical bodies are assembled alternately to form the tube. The cylindrical bodies have step-shaped ends to engage the edges of the discs, and an electrically conducting binding agent is used on the adjoining surfaces. Advantages of this method of construction include high efficiency and precision in construction and high smoothness of the finished surfaces. (TCO)

23842 DEVICE FOR STABILIZING THE ACCELERATING VOLTAGE IN THE PULSE OPERATION OF A PARTICLE ACCELERATOR. Oigami, Hiroshi (to Mitsubishi Atomic Power Industry, Inc.). Japanese Patent 1964-14360. July 8, 1965. Filed Dec. 26, 1963.

The particle accelerator described includes a slit, an electromagnet for deflecting the accelerated particle beam,

and a beam deflector. Because the direction of a magnetic field applied for the deflection, and of an electric field for the pulsed deflection are the same, the two different deflections are independent. Thus, whether the accelerated beam is pulsed by its deflector before the electromagnet or behind it, the deviated (accelerating) voltage can be detected, and a stabliized accelerating voltage can be provided. (NSA of Japan)

23843 CHARGED-PARTICLE ACCELERATING DEVICE. Komai, Kenichiro (to Hitachi, Ltd.). Japanese Patent 1964-15740. July 21, 1965. Filed June 15, 1963.

In the proposed charged-particle accelerating device, the valve for a leak-device is closed when the accelerator is not in operation. The accelerating tube can then be sufficiently evacuated with a diffusion pump for cleaning the electrodes. When the accelerator is operated, the leak valve is opened, and an inert gas is introduced into the accelerating tube. In this way, the electric discharge voltage in the accelerating tube can be made sufficiently high with simple construction, and a high vacuum can be maintained in an electron microscope connected thereto. (TCO)

23844 ELECTROMAGNETS FOR A BETATRON. Suzuki, Yosuke (to Shimazu Seisakusho Ltd.). Japanese Patent 1964-18560. Aug. 20, 1965. Filed Sept. 23, 1963.

Improved electromagnets for a betatron are proposed so that the non-uniform part of the accelerating magnetic field is minimized, increased yield of x rays is realized, and the change of the electromagnets with the passage of time is reduced. The electromagnets are constructed as two opposing yokes, and the parts of the yokes are plain-finished. A concave hollow is cut respectively in each part of the yoke; thus a correction can be made for the non-uniformity of the magnetic field. (TCO)

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Refer also to abstracts 23474, 23919, 24350, and 24367.

23845 MEASUREMENT OF THE TEMPERATURES OF MOLECULES IN COOL STARS. Phillips, John G. (Univ. of California, Berkeley). Appl. Opt., 5: 549-53(Apr. 1966).

The spectra of red stars display a complex profusion of atomic and molecular absorption lines and bands. The overlapping of successive absorptions is so severe that the usual methods of temperature measurement cannot be applied. Instead, an indirect procedure has been attempted involving the calculation of a theoretical absorption profile based on a simple model, and comparison with observation. The results show that the detailed stellar profile is relatively insensitive to excitation temperature, so that this particular stellar parameter is relatively uncertain. (auth)

23846 TYPE IV BURSTS. I. LIST OF EVENTS. Svestka, Z.; Olmr, J. (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 17: 4-16(1966).

A list of 174 type IV events recorded during 1956–1963 is given. This catalog is based on Sydney, Harvard and Boulder dynamic spectra, single frequency summaries published in the Quarterly Bulletin on Solar Activity and single frequency records at Ondřejov. One can estimate that about 75% of all type IV bursts which occurred on the Sun during the years 1956–1963 are included in the catalog. (auth)

23847 NUCLEAR REACTIONS IN STARS AND SOLAR NEUTRINOS. Kocharov, G. E. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1734-9(Sept. 1965). (In Russian).

The rates in the interior of a star of the reactions of the proton-proton cycle (including side reactions involving ^{7}Be, ^{7}Li, ^{8}B, and ^{8}Be) were calculated as functions of the temperature. It was assumed that in the center of the star the concentrations by weight of hydrogen and helium are each 48% and, for those reactions that have not had time to come to equilibrium, that the central density and age of the star are 145 g/cm^3 and 5×10^9 years, respectively. The calculated concentrations of the various reactants and the rates of the reactions are presented graphically. From these results the rate of the $^{37}Cl(\nu,e^-)^{37}Ar$ reaction at the earth due to solar neutrinos was calculated as a function of the central solar temperature, with two different assumptions concerning the contribution of the carbon-nitrogen cycle to solar energy production. Experimental difficulties encountered in observing the neutrino reaction are discussed briefly. From the upper limit found previously for the rate of this reaction it is concluded that the central temperature of the sun does not exceed 18×10^6°K. (ATD)

23848 NEUTRINO EMISSION AND THERMOMETRY OF THE SOLAR INTERIOR. Kuz'min, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1743-5(Sept. 1965). (In Russian).

Observation of solar neutrinos could provide information not otherwise obtainable concerning the interior of the sun. It is shown with the aid of a simplified solar model how the internal temperature of the sun could be derived from such observations. The responses of ^{37}Cl, ^{71}Ga, and ^{79}Br neutrino detectors to solar neutrinos arising from different reactions are calculated as functions of the internal temperature of the sun, and the results are presented graphically. The ^{71}Ga detector is the most sensitive of the three discussed, but the responses of the other two detectors are more strongly temperature dependent in the range (12 to 20) $\times$ 10^6°K. (ATD)

23849 SEVERAL PROBLEMS ON THE GENERATION OF COSMIC RAYS BY THE SUN AND THEIR PROPAGATION INTO INTERPLANETARY SPACE. Charakhch'yan, A. N.; Charakhch'yan, T. N. (Lebedev Inst. of Physics, Moscow. Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1800-4(Oct. 1965). (In Russian).

The differential energy spectrum of protons may be expressed as an exponential function with exponent 6 at energies of several hundred Mev. The spectral exponent is found to equal 3 before the arrival of corpuscular streams from a solar flare and reach the value 6 when the earth is in a chromospheric-flare stream. The spectral exponent 3 is ascribed to protons diffusing freely into interplanetary space from the sun and reaching the earth earlier than the proton stream carried by magnetic traps and propagating slowly, to which the exponent 6 is related. The constancy of energy spectra of flares indicates that the particle acceleration in flares is constant and independent of solar atmospheric processes. Data from measurements of differential spectra of protons, α particles and medium-weight nuclei are shown. Intensity ratios of α particles/protons and nuclei/protons, determined from various flares, are given. (M.J.T.)

23850 ZONE OF INCIDENCE OF SOLAR PARTICLES DURING THE MAXIMUM AND MINIMUM OF SOLAR ACTIVITY. Ivanov, V. I.; Kolomeets, E. V. (Kazakh State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1807-9(Oct. 1965). (In Russian).

Results of previous measurements of the intensity of solar cosmic particles at various stations are discussed in an attempt to explain the inverse correlation between levels of solar activity and the presence of a zone of incidence of the solar particles at the earth. The absence of an impact zone in the years of maximum solar activity (1957-58) is thought to be due to a high density of inhomogeneities in the interplanetary magnetic fields, the strong perturbation in the earth's magnetosphere, and the very short duration of the cosmic-ray anisotropy. Data indicating the appearance of a zone of incidence in the years of decline and minimum of solar activity are discussed. (M.J.T.)

23851 SOLAR COSMIC RAYS FROM THE FLARE OF 28 SEPTEMBER 1961 AND THE PROPERTIES OF INTERPLANETARY SPACE. Dorman, L. I.; Miroshnichenko, L. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1810-12(Oct. 1965). (In Russian).

Measurements by Explorer 12 of the cosmic-ray intensity during the solar flare of Sept. 28, 1961, are compared with

the predictions of a diffusion theory of cosmic-ray propagation. Agreement is obtained by assuming that the particles began to be emitted when the x-ray burst reached its maximum about 15 min after the onset of the flare. The scattering mean free path was almost independent of particle energy for energies from 10 to 500 Mev and was approximately 7.5×10^{11} cm. The differential emission spectrum is found to be 5.6×10^{34} E^{-2} protons/Mev, where E is the kinetic energy. A lower limit of 5×10^{-6} G is found for the strength of the magnetic-field inhomogeneities. If it is assumed on the basis of measurements by Mariner 2 that the strength of the inhomogeneities is 10^{-4} G, the linear dimension of such an inhomogeneity is found to be approximately 4×10^{10} cm —about half the distance between the inhomogeneities. (ATD)

23852 ON THE ORIGIN OF THE CONTINUOUS ELECTROMAGNETIC RADIATION INCIDENT TO SOLAR FLARES. **Korchak, A. A. (Inst. of Terrestrial Magnetism, The Ionosphere, and Radio Wave Propagation, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1813-18(Oct. 1965). (In Russian).**

Literature on the electromagnetic radiation accompanying solar flares is reviewed. Possible radiation mechanisms, including synchrotron radiation, bremsstrahlung, and Compton scattering of thermal photons on relativistic electrons, are discussed. The r-f emission is synchrotron radiation. The millimeter and x radiation are closely associated and are probably both due to the same electrons. The meter radiation is relatively independent of the harder radiation and is produced in the corona. An intensity maximum of solar-flare emission is found in the ir. It is considered likely that the hard x rays are bremsstrahlung arising from nonrelativistic electrons accelerated in the flare development and that the millimeter and centimeter emissions represent cyclotron radiation from relativistic electrons of the same group. Meter emission occurs only when the electron density is high enough so that a significant number of electrons reach the corona. (M.J.T.)

23853 RELATIVISTIC ELECTRONS IN THE M82 GALAXY. **Ginzburg, V. L.; Ozernoi, L. M.; Syrovatskii, S. I. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1825-9(Oct. 1965). (In Russian).**

Formulas are presented for calculating the energies and energy losses of the relativistic electrons in the M82 galaxy —particularly with respect to the total energy of the light-emitting relativistic electrons, the energy losses due to the Compton effect, and the energy losses due to magnetic bremsstrahlung. It is shown that the total flux of Compton γ rays from M82 equals the Compton losses. An evaluation of the γ flux due to the decay of π^0 mesons and bremsstrahlung is presented. The magnetic x-ray bremsstrahlung of M82 is evaluated on the assumption that the optical spectral index of M82 is close to the optical index $\alpha = 1.5$ of the Crab Nebula. (M.J.T.)

23854 INTERSTELLAR AND INTERGALACTIC MEDIA. **Kaplan, S. A.; Pikel'ner, S. B. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1830-7(Oct. 1965). (In Russian).**

Previous experimental and theoretical studies are used to give a general picture of the distribution and motion of the interstellar medium. The distribution, motion, and temperature of the interstellar gas, which consists of 60% hydrogen, are described, with discussion of the division into disk and corona or halo components. The composition and distribution of interstellar molecules and dust are considered. The interstellar magnetic-field distribution is described, showing specific results from previous works. Results on the intergalactic medium, including composition, ionization state, and magnetic-field distribution, are summarized. (M.J.T.)

23855 SOLAR CORPUSCULAR STREAMS WITH FORCE-FREE MAGNETIC FIELDS. **Mogilevskii, E. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1881-7(Oct. 1965). (In Russian).**

The theory of force-free magnetic fields in solar corpuscular streams is reviewed. In a force-free field, the current is everywhere parallel to the field so that the Lorentz force vanishes; this configuration corresponds to minimum energy for a fixed volume and is thus thermodynamically stable. Force-free fields in which the plasma velocity is proportional to the field are observed on the sun; a detached chromospheric force-free magnetic field with its plasma cloud is accelerated toward or away from the sun. The solar corpuscular stream consists of a sequence of ejected plasma clouds, called M-elements, propagating in the interplanetary plasma. The transfer of energy to the earth's magnetosphere by the dipole magnetic fields of M-elements passing the earth is discussed. Solar cosmic rays are either entrapped in the field of the corpuscular stream or scattered by the M-elements. The structure of the field of the corpuscular stream during the geomagnetic disturbance of Oct. 7-8, 1962, is discussed, using data reported by Mariner 2. (M.J.T.)

23856 THE PROBLEM OF THE DISTRIBUTION OF IONIZED GAS NEAR THE GALACTIC PLANE. **Razin, V. A.; Khizhnyakova, I. P. (Gorkii State Univ., USSR). Izv. Vyysh. Ucheb. Zaved., Radiofiz., 8: 822-4(1965).**

In a recently published paper, F. H. Hoyle and V. R. A. Ellis assumed that a layer of ionized gas exists near the galactic plane, which changes the spectrum of cosmic radio emission in the frequencies of 1 to 10 Mc. The density of ionized gas in that layer amounts to about 0.1 cm^{-3}, and its temperature is about 10^4 K. The half thickness of the layer is 300 psc. This assumption was criticized as impossible given the assumed state of the layer. Others indicate that about 90% of polarized radiation is distributed nonuniformly in a belt which is 50 deg wide and passes through the poles of the galaxy. A systematic decrease of the intensity of polarization does not occur from the middle to the border, and the electric vector in several places is located along the belt. Two models of the galaxy are discussed in the original article. The first model assumes a uniform distribution of the ionized gas in the spiral containing the solar system; the second model assumes a concentration of the ionized gas in dense clouds. Theoretical investigations do not confirm the possibility of either the first or the second model. A combination of both models, allowing a cloudy structure of the ionized gas and the Faraday rotation in interstellar space, may prove the polarization of cosmic radiation on frequencies 207, 408, and 610 Mc. (ATD)

23857 EVIDENCE FOR THE POSSIBLE EMISSION OF HIGH-ENERGY NEUTRONS FROM THE SUN. **Apparao, M. V. Krishna; Daniel, R. R.; Vijayalakshmi, B. (Tata Inst. of Fundamental Research, Bombay). J. Geophys. Res., 71: 1781-5(Apr. 1, 1966).**

From a balloon flight made from Hyderabad, India (geographic latitude 17.3°N and longitude 78.5° E and geomagnetic vertical cutoff rigidity 16.9 Gv), on March 23, 1962, the flux of neutrons in the energy region 4–160 Mev was determined by making observations on tracks of protons recoiling from elastic collisions of neutrons with hydrogen nuclei present in nuclear emulsions that were freshly coated for this experiment. An analysis of the data obtained from these emulsions and other control emulsions provided evidence for the possible emission of neutrons from the sun in the energy interval of 20–160 Mev; the flux obtained is 148 ± 60 neutrons/m^2 sec. The balloon flight was made on a day when the sunspot number was at its peak of the 27-day variation and 6 hours after an optical flare of magnitude 3, which produced no particle intensity variations or geophysical effects at the earth. (auth)

23858 SOLAR PROTON EVENT OF FEBRUARY 5, 1965. **Paulikas, G. A.; Freden, S. C.; Blake, J. B. (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res., 71: 1795-8(Apr. 1, 1966).**

Solar protons reached the vicinity of the earth after the class 2 solar flare of February 5, 1965, and were measured from satellite 1964-45A. Four hours after the flare the integral fluxes above 10 Mev, 20 Mev, 40 Mev, and 80 Mev were, respectively, 350, 250, 100, and 5 protons/cm^2 sec. These fluxes decayed with time constants ranging from 16.8

hours for the lowest energy threshold to 4 hours for the highest energy threshold. Changes in the fluxes by a factor of ≈3 that occurred within a time of minutes were also observed. (auth)

23859 ABUNDANCES OF SELENIUM, TELLURIUM, AND INDIUM IN METEORITES. Akaiwa, Hideo (Univ. of Chicago). J. Geophys. Res., 71: 1919-23(Apr. 1, 1966).

The following abundances (atoms per 10^6 Si atoms) were measured by neutron activation analysis in three carbonaceous chondrites of types I, II, III, and one enstatite chondrite of type I. Se: 53, 15.2, 6.4; Te: 6.9, 3.2, 1.67, 4.1; In: 0.26, 0.094, 0.049, and 0.19. This abundance pattern supports the view that chondrites are a blend of two types of material: a high-temperature fraction (chondrules plus metal) from which the volatiles were lost, and a low-temperature fraction (matrix), which retained its volatiles. The data also suggest that the cosmic abundance curve in the Cd-I region may have to be raised by a factor of 2 over previous estimates. The abundances of Ga and In in the chondrite Renazzo are 11.9 and 0.036 on the Si = 10^6 scale. These figures, together with other compositional data, suggest that Renazzo occupies an intermediate position between the carbonaceous and bronzite chondrites, rather than belongs to either class. (auth)

23860 SOLAR RADIO BURSTS AT NIGHT. Fortini, Teresa (Osservatorio Astronomico di Rome); Garcia, Charles; Gay, Marjorie; Glover, Francis. J. Geophys. Res., 71: 1938-9(Apr. 1, 1966).

The records representing the level of 18-Mc galactic noise received on four vertically beamed antennas distributed throughout the world are presented, which show strong solar bursts appearing throughout the observation period 2000 to 2300 UT. A plausible explanation is given for the succession of bursts propagated into the night hemisphere, which is believed to be the first case established. (L.B.S.)

23861 STABILITY OF ROTATING MASSIVE STARS IN GENERAL RELATIVITY. Durney, B.; Roxburgh, I. W. (High Altitude Observatory, Boulder, Colo. Univ. of London). Nature, 208: 1304-5(Dec. 25, 1965).

The principal results of an investigation of the stability of rotating massive stars in general relativity are presented. The general relativistic equations given by Misner and Sharp and by Chandrasekhar in a weak field approximation are utilized with emphasis on slow rotation and integration of the equations over latitude, thereby leaving purely radial variables. (B.G.D.)

23862 OUTER SOLAR CORONA DURING THE DECLINING PORTION OF THE SOLAR ACTIVITY CYCLE. Slee, O. B. (Royal Radar Establishment, Great Malvern, Eng.). Planet. Space Sci., 14: 255-67(Mar. 1966).

Some previously unpublished observations of the coronal radio scattering made in Sydney during 1962 are combined with observations made at various observatories in the two-year interval 1960–1962 to deduce the dependence of scattering on solar activity in the range of angular separations 20–80 $R_\odot$. During a period of declining solar activity, the magnitude of the scattering has decreased by a factor of three, the anisotropy in the scattered distributions has been markedly reduced, the radial gradient of scattering in the Sun's equatorial plane has remained close to –1.4, and the shape of the scattering corona has retained approximately the same degree of ellipticity. The interpretation of the observed radial variation of scattering suggests a discrepancy between the radio and optical values of electron density close to the Sun. This may be resolved by assuming that the irregular component of electron density changes from a small fraction of the total at 5 $R_\odot$ to dominate the corona at angular distances greater than 50 $R_\odot$. A comparison is made between these scattering results and those derived from the observations of decametric Jupiter bursts, if these are regarded as the manifestations of a similar scattering process in operation at distances greater than 1 a.u. from the Sun. (auth)

23863 PHOTOELECTRIC SPECTROPHOTOMETRY OF η CARINAE. Aller, L. H. (Univ. of California, Los Angeles). Proc. Nat. Acad. Sci. U. S., 55: 671-6(Apr. 1966).

Spectrophotometry measurements of η carinae with the Michigan photoelectric scanner are discussed. Measurements were made of the energy distribution in the continuum, the relative intensities of the emission lines, and the absolute fluxes in terms of ergs cm^{-2} sec^{-2} reaching to the top of the earth's atmosphere by calibrating one or more of the stronger lines. (B.G.D.)

23864 ON THE EFFECTS OF THE NON-CONSERVATION OF BARYONS IN COSMOLOGY. Hoyle, F.; Narlikar, J. V. (California Inst. of Tech., Pasadena). Contract Nonr-220(47). Proc. Roy. Soc. (London), Ser. A, 290: 143-61(Feb. 22, 1966).

The idea underlying the discussion is that the massive objects, now known to be associated with radio sources and with quasi-stellar objects, are of cosmological significance; and that the energy output of these objects is associated with the problem of creation in cosmology. The same equations describing creation of matter are used, as before; but account is taken of the fact that they contain far wider cosmological implications than were explored hitherto. Only the more conventional aspects of the steady-state theory are considered. Full exploration of the creation process leads to a radical departure from the old steady-state concept. (auth)

23865 A RADICAL DEPARTURE FROM THE "STEADY-STATE" CONCEPT IN COSMOLOGY. Hoyle, F.; Narlikar, J. F. (Univ. of Cambridge, Eng. California Inst. of Tech., Pasadena). Contract Nonr-220(47). Proc. Roy. Soc. (London), Ser. A, 290: 162-76(Feb. 22, 1966).

The results presented are based on an entirely different choice of the undetermined coupling constant f which appears in the theory of creation of matter. Previously f was chosen to make the steady-state expansion rate coincident with the observed expansion rate. Now that a much larger value is taken for f, the corresponding steady-state expansion rate is much greater than the observed value. This difference is interpreted as showing a wide, possibly temporary, fluctuation from the steady-state situation. The expansion rate in such a fluctuation follows the Einstein–de Sitter relations. The natural scale set by the new steady state corresponds to the masses of clusters of galaxies, $10^{13}M_\odot$ is obtained instead of $10^{23}M_\odot$ for the "observable universe". It is suggested that elliptical galaxies were formed early in the development of a fluctuation. The discussion of high-energy phenomena leads to immediate explanations of the energy spectrum of cosmic rays, of the presence of e^+ in cosmic rays and of the rate of energy production associated with radio sources. (auth)

23866 RECENT WORK ON THE INTERSTELLAR MEDIUM. Dieter, Nannielou H.; Goss, W. Miller (Univ. of California, Berkeley). Rev. Mod. Phys., 38: 256-97 (Apr. 1966).

Emphasis in this review of current problems in the study of the interstellar medium is on a few specialized topics. The first treated is the problem of the cloud structures and the velocity fields in the interstellar gas. Another section deals with the observations suggesting the presence of dust as well as gas in the medium and with the proposed nature of the dust grains. These grains were the first indicators of the presence of a general galactic magnetic field and are believed to be catalytic agents in the formation of molecules in the gas. The status of current observational investigations of the magnetic field and of current theoretical studies of the formation of interstellar molecules is described. Finally, very recent observations in the microwave spectrum of the hydroxyl radical are outlined. These suggest the availability of new and surprising information about conditions in the interstellar medium. (auth)

23867 SOLAR AND INTERPLANETARY MAGNETIC FIELDS. Wilcox, John M. (Univ. of California, Berkeley). Science, 152: 161-6(Apr. 8, 1966).

The relation between the pattern of the photospheric

fields observed with the solar magnetograph and the pattern of the interplanetary magnetic fields near the position of the earth was investigated in terms of the large-scale direction of the fields. The latitude on the sun of the regions that constitute the source of the interplanetary magnetic field that sweeps past the earth was studied with regard to solar differential rotation. Analysis of the solar wind parameters indicated that the sector structures are a fundamental property of the interplanetary medium. Measured directions of the interplanetary magnetic field at successive 3-hr intervals suggested the sector structure. (M.C.G.)

23868 THE ABUNDANCE OF THE ELEMENTS. Urey, Harold C. (Univ. of California, San Diego). Select. TRW Space Technol. Lab. Lect. Ser., 2: 35-46(1965).

An attempt is made to understand what the primitive abundances of the elements were, and thus, how they were produced by physical processes in the stars or elsewhere. The sampling of meteorites and the comparison of this data to the solar spectrum technique is discussed. This investigation also involves an understanding of how the solar system evolved, and how meteorites, the moon, the terrestrial planets, and the surface of the earth got their composition. (B.G.D.)

23869 ENERGETIC SOLAR PARTICLES. Anderson, Kinsey A. (Univ. of California, Berkeley). Select. TRW Space Technol. Lab. Lect. Ser., 2: 51-60(1965).

An empirical description of the observed properties of solar-particle emission and certain consequences of these radiations are presented. The term solar energetic radiation includes the spectrum of radiation of solar origin, containing energies appreciably above the thermal energies associated with the quiet sun. A historical summary of observed energetic solar particles is included along with a discussion on the properties of solar radiation. (B.G.D.)

23870 THE ORIGIN OF PLANETARY ATMOSPHERES. Cameron, A. G. W. (Goddard Space Flight Center, Greenbelt, Md.). Select. TRW Space Technol. Lab. Lect. Ser., 2: 61-70(1965).

A formal scheme is presented which lists mechanisms for input of gases into an atmosphere and mechanisms for loss of gases from an atmosphere. Two capture processes, one from a primitive solar nebula; and the other from the solar wind, are considered as well as two loss processes one of which is through the interaction of the atmosphere with the solar wind and the other which is the evaporation process. A general process of chemical reactions and a hypothetical process which would lead to a loss of an atmosphere are also included. A review is presented on planetary atmospheres to examine cases in which one or more of these processes have been important in producing the actual state of the atmosphere in different planets. (B.G.D.)

Atomic Physics

Refer also to abstracts 23420, 24108, and 24438.

23871 (AD-625519) THE ELASTIC SCATTERING OF LOW-ENERGY ELECTRONS FROM ATOMIC HELIUM [Thesis]. LaBahn, Raymond W. (Naval Ordnance Lab., Corona, Calif.). Nov. 24, 1965. 140p. (NAVWEPS-8824). CFSTI $4.00 cy, $1.00 mn.

Electron elastic scattering from atomic helium is examined within the framework of perturbed Hartree-Fock theory for the energy region from 0 to 50 ev. Interaction potentials are derived to describe the distortion induced in the target atom by the incident electron in the adiabatic approximation. Dynamical corrections to the adiabatic approximation are also examined and are incorporated into the formalism through a "velocity-dependent" potential. The s-, p-, and d-wave scattering phase shifts are computed by numerical iteration of the resulting equations. These phase shifts are then used to compute the elastic scattering cross sections, and the results are compared with other recent theoretical predictions and experimental data. (TAB)

23872 (AEET-236) METALLIC HALIDE ELECTRODELESS DISCHARGE LAMPS. Ramakoteswara Rao, P.; Ghosh, P. C.; Balasubramanian, T. K.; Bhale, G. L. (Atomic Energy Establishment, Trombay (India)). 1965. 17p. Dep. mn.

Several electrodeless discharge lamps were prepared for the purpose of studying the atomic spectra of the heavier elements. In particular, ThI_4, $FeCl_3$, and UI_4 lamps were prepared. The method used to prepare these electrodeless lamps is described along with some salient features in the spectra emitted by them such as selective excitation of elements and self-reversal. (M.O.W.)

23873 (ANL-7108, pp 37-41) BLOCKING EFFECTS IN THE EMERGENCE OF CHARGED PARTICLES FROM MONOCRYSTALS. Gemmell, D. S.; Holland, R. E. (Argonne National Lab., Ill.).

The blocking of charged particles that have been emitted from lattice sites by the nearest neighbors of the emitting atom was investigated by observing proton scattering at large angles by single crystals of Ge and Si. The results indicate that the blocking occurs in the direction of crystal planes rather than along axes. (D.C.W.)

23874 (ANL-7108, pp 43-56) ELECTRON EMISSION FROM METAL MONOCRYSTALS UNDER HIGH-ENERGY ION IMPACT. Kaminsky, Manfred (Argonne National Lab., Ill.).

The (100), (110), and (111) planes of single crystals of Cu were bombarded with deuterons, He^+ ions, and protons at normal incidence and at energies ranging from 0.2 to 1.0 Mev. The energy distributions and yields of secondary electrons were measured. It was found that the yield of secondary electrons depends distinctly on the crystalline orientation of the emitting surface, contrary to theoretical predictions. (D.C.W.)

23875 (BNL-10040) THE SPIN POLARIZED HARTREE-FOCK METHOD AND THE CONTRIBUTION OF CORE POLARIZATION TO HYPERFINE FIELDS OF 4d IONS. Freeman, A. J. (National Magnet Lab., Massachusetts Inst. of Tech., Cambridge); Bagus, P. (Argonne National Lab., Ill.); Watson, R. E. (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 8p. (CONF-660604-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

For Presentation at Magnetic Hyperfine Structure of Atoms and Molecules Meeting, Paris.

A study was made of the contribution of core polarization to observed hyperfine fields, H_c, of 4d ions using the spin-polarized Hartree-Fock (SPHF) method. As a starting basis analytic restricted Hartree-Fock solutions obtained previously were used. Results obtained for the ^6S state ions Mo^+, Tc^{2+}, and Ru^{3+} and for Pd^{2+} and Pd^{3+}, show that H_c is large and negative and is due almost entirely to the negative 2s and 4s contributions; the small 3s contribution is positive. While the individual s-shell contributions vary with ion, H_c per spin is constant (to within 5%), unlike the much cruder constancy noted earlier for the 3d ions. Detailed comparisons are made with earlier results for the 3d ions. H_c per unpaired spin is found to be ~ -375 kG per unpaired spin, in very good agreement with experiments on Pd metal, e.g., from Knight shift measurements, Seitchik et al. find that H_c per spin is -345×10 kG per unpaired spin. (auth)

23876 (CERN-65-24(Vol. 2)), pp 89-106) VARIATION OF IONIZATION WITH VELOCITY. O'Ceallaigh, C. (Dublin Inst. for Advanced Studies (Ireland)).

Some investigations of the variation of ionization with velocity in condensed media, in which nuclear emulsions were used, are briefly discussed; and a procedure for comparing experimental measurements with the Bethe-Bloch and Sternheimer theories is outlined. (D.C.W.)

23877 (CONF-758-62) STOCHASTIC WAVE FUNCTION FOR ATOMIC HELIUM. Kalos, M. H. (Courant Inst. of

Mathematical Sciences, New York Univ., N. Y.). [1965]. Contract AT(30-1)-1480. 41p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Physical Society Meeting, New York, Jan. 1965.

A method is given for random sampling which yields a density equal to the ground state wave function for the helium atom. As an intermediate step, a Green's function for the diffusion operator containing the repulsive interaction is sampled. A technique for generating a density function proportional to ψ^2 is outlined. Attention is paid to the development of estimators with finite variance. Results are shown for the electron density and for r^2. The latter agrees well with previous numerical results. (auth)

23878 (N-65-32549) INVESTIGATION OF KILOVOLT ION SPUTTERING. Quarterly Progress Report. Smith, Harold P. Jr.; Hurlbut, F. C.; Pigford, T. H. (California Univ., Berkeley. Space Sciences Lab.). July 31, 1965. 51p. (NASA-CR-54406). CFSTI $3.00 cy, $0.50 mn.

The investiagation of cesium-ion sputtering of monocrystalline copper using a radioactive tracer technique continued. The yield and angular distribution of sputtered copper were measured as a function of cesium ion energy from 1 to 10 kev. It was found that temperature variation had little effect, but that alignment of the beam parallel to a high (Miller) index direction greatly enhanced the yield. The angular data was successfully fitted to an analytic function through use of a non-linear regression analysis. This method will be used to describe the effects of the above parameters on the angular distribution. Further progress in the development of a mercury ion sputtering apparatus and of a time-of-flight velocity spectrum technique is presented, as well as initial work in developing a technique for measuring small surface densities through use of proton-induced characteristic x-rays. Finally, a project to study saturated ion implantation distributions was initiated. An analysis of expected distributions using a linear model of the combined implantation-sputtering phenomena is presented. (STAR)

23879 (N-65-32721) CALCULATION OF HYDROGEN ATOM CROSS SECTIONS. Final Report. Pomilla, Frank R.; Milford, S. N. (Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.). May 1965. Contract NASw-894. 82p. (NASA-CR-64455). CFSTI $3.00 cy, $0.75 mn.

Born cross sections for double inelastic collisions between two hydrogen atoms are calculated. The case in which one of the atoms is initially in the ground state and the case in which both atoms are initially in excited states are studied for center of mass energies in the range 2kev to 100 Mev. The hydrogen atom-hydrogen atom Born differential cross section is formulated in terms of the electron-hydrogen atom Born differential cross sections for each of the colliding atoms. This formulation was chosen so that an existing IBM 7094 computer program for the evaluation of the electron-hydrogen Born differential cross sections could be used to calculate the hydrogen atom-hydrogen atom Born differential cross sections. The hydrogen atom-hydrogen atom total cross sections are calculated by numerical integration of the differential cross sections. The numerical results of the computer calculations are shown and are discussed. (STAR)

23880 (UCRL-14776) A REVIEW OF THE MEASUREMENTS OF ELECTRON-INDUCED POLARIZED OPTICAL RADIATION NEAR THRESHOLD. McFarland, Robert H. (Lawrence Radiation Lab., Univ. of California, Livermore). Mar. 23, 1966. Contract W-7405-eng-48. 11p. (CONF-660512-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Electron Excitation of Atomic Vapor, Applications to Spectroscopy Seminar, Grenoble, France.

Some methods of studying the polarization of the optical radiation produced by electron impact on atoms are briefly discussed together with some measurements of polarization. (D.C.W.)

23881 CHARACTERISTIC ENERGY LOSSES OF ELECTRONS IN DIAMOND. Whetten, N. R. (General Electric Co., Schenectady, N. Y.). Appl. Phys. Lett., 8: 135-7 (Mar. 15, 1966).

The energy loss spectrum of electrons reflected from the surface of a diamond crystal was measured directly using a 127° electrostatic analyzer. A peak was observed at 31 ev, which corresponds to the plasma excitation energy. In addition, a loss near 12.5 ev was observed, which appears to be consistent with an interband transition reported in optical measurements. (L.B.S.)

23882 INFLUENCE OF CHANNELING ON Cu SINGLE-CRYSTAL SPUTTERING. Onderdelinden, D. (FOM-Laboratorium voor Massascheiding, Amsterdam). Appl. Phys. Lett., 8: 189-90(Apr. 15, 1966).

Directional effects observed in sputtering measurements on Cu single crystals by 2- to 20-kev Ar^+ ions are investigated, and the possibility of describing the observed effects using the theory of Lindhard for channeling of energetic ions in a crystal lattice is shown. (L.B.S.)

23883 THE DETERMINATION OF ATOMIC COLLISION CROSS SECTIONS USING CROSSED ELECTRON AND ION BEAMS (AND SOME SOURCES OF ERROR IN SUCH EXPERIMENTS). Harrison, M. F. A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Brit. J. Appl. Phys., 17: 371-82(Mar. 1966).

Application of the method of crossed beams to the study of collisions between electrons and ions is discussed. Basic principles of the design of a collision region are given and an expression is derived for the collision cross section in terms of the measured electron and ion collision rate. The experimental parameters associated with the derivation are discussed. Simple theories are developed that enable corrections to be made to the measured collision rates to allow for the space-charge effects of ion and electron beams. Experimental evidence supporting these theoretical predictions is given. (auth)

23884 TEMPERATURE INFLUENCE OF THE PRESSURE SELF-BROADENING OF THE ^{113}Cd RESONANCE LINE 3261 A AND ITS HYPERFINE STRUCTURE COMPONENTS. Misiunas, A.; Valuzis, A. (Kapsukas State Univ., Vilnius, USSR). Lietuvos Fiz. Rinkinys, Lietuvos TSR Mokslu Akad., Lietuvos TSR Aukstosios Mokyklos, 5: 259-70(1965). (In Russian).

The influence of temperature and number of collisions between excited and perturbing ^{113}Cd atoms upon the broadening, shift of maximum, and asymmetry of the resonance line of ^{113}Cd 3261 Å and its hyperfine structure components was investigated. The temperature broadening of this line was investigated by means of the total absorption method. The constant concentration of ^{113}Cd vapor in a sealed silica absorption tube was $N = 3.2\ 10^{17}$ atoms per cc. The half breadth of the investigated line showed the tendency to increase with increase of temperature from 993 to 1253°K, but the increase was very small and remained in the limits of measurements errors. The line possessed asymmetry toward the red of the value U = 1.67, which did not change by increasing temperature of the tube. The broadening of hyperfine structure components was investigated by means of Fabry–Perot interferometer and silica spectrograph. The constant concentration of ^{113}Cd vapor was $N = 2.5\ 10^{13}$ atoms per cc. Increasing temperature from 733 to 1253°K half breadth of component a increased (11 ± 5) % and half breadth of component b–(10 ± 5)%. The investigated components of ^{113}Cd resonance line were found symmetric. The shift of maximum of hyperfine-structure components was not observed. The results of the investigations cannot be fully evaluated by collision theories. (auth)

23885 HIGHLY-POLARIZED COHERENT BREMSSTRAHLUNG FROM A DIAMOND TARGET IN THE Gev REGION. Bologna, G.; Lutz, G.; Schulz, H. D.; Timm, U.; Zimmermann, W. (Deutsches Elektronen-Synchrotron, Hamburg). Nuovo Cimento (10), 42: 844-55(Apr. 21, 1966).

The production of coherent bremsstrahlung from a crys-

talline target has been discussed by several authors. Experimental results were first obtained for 1 Bev with a diamond by Barbiellini et al., who explained the sharp discontinuities of the spectra by taking into account the actual structure of the reciprocal lattice. The bremsstrahlung spectra obtained from a diamond radiator at an electron energy at 4.8 Bev is presented. The work has essentially two results: (1) The exponentially screened potential of the C atom which has been used earlier in calculating the bremsstrahlung cross-section is not consistent with the experimental spectra. Instead a Hartree-type screening potential was used, which fits the data very well. (2) The linear polarization obtained from the first peak in a spectrum is much increased, if the orientation of the primary electron momentum is chosen to lie not in the fundamental reference planes of the crystal but at a small angle to one of them. (auth)

23886 QUANTUM-MECHANICAL GENERATORS OF THE GROUP $O_{4,1}$ FOR HYDROGEN-ATOM BOUND STATES. Han, M. Y. (Syracuse Univ., N. Y. Univ. of Pittsburgh). Nuovo Cimento (10), 42B: 367-70(Apr. 11, 1966).

A Lie algebraic method is presented with which quantum mechanical noncompact generators of the group $O_{4,1}$ can be found in a simple manner for hydrogen-atom bound states. The method is based upon the observation that the $O_{4,1}$ algebra and a particular subalgebra of the enveloping algebra of the Poincare algebra have the same complex expansion. (L.B.S.)

23887 CROSS SECTIONAL DISTRIBUTION OF EXCITED ATOMS IN A LOW-PRESSURE DISCHARGE IN MERCURY VAPOR AND IN A MIXTURE OF MERCURY VAPOR AND ARGON. Uvarov, F. A.; Fabrikant, V. A. Opt. Spektros., 18: 954-65(1965).

The Rozhdestvenskiy anomalous dispersion (hook) method is used for studying the distribution of excited atoms in the cross section of a low-pressure discharge in mercury vapor and in a mixture of mercury vapor and argon. Experimental results are compared with theoretical data which take account of transitions between excited states. It was found that the distribution of radiating atoms agrees with the exact theory of L. M. Biberman and B. A. Veklenko. This indicates that transitions between excited states have only a slight effect on distribution due to the strong, smoothing effect of diffusion in resonance radiation. On the other hand, the distribution of metastable atoms is sharpened considerably by $6^3P_1 \rightarrow 6^3P_2$ transitions, especially in the mercury + argon discharge. In spite of qualitative agreement between experiment and theory, there are quantitative discrepancies for the mercury + argon discharge. It is possible that the cause of these discrepancies may be underestimation of the effective cross sections for $6^3P_1 \rightarrow 6^3P_2$ processes and radial nonuniformity of the temperature and gas composition in the discharge column. (ATD)

23888 ISOTOPE SHIFTS IN MUONIC X RAYS OF $^{118,119,120}Sn$, $^{142,144,146}Nd$ AND $^{182,184,186}W$. Bardin, T. T.; Barrett, R. C.; Cohen, R. C.; Devons, S.; Hitlin, D.; Macagno, E.; Nissim-Sabat, C.; Rainwater, J.; Runge, K.; Wu, C. S. (Columbia Univ., New York). Phys. Rev. Lett., 16: 718-21(Apr. 18, 1966).

The muonic x-ray spectra in isotopes of Sn, Nd, and W are studied to achieve an understanding of the relation between muonic and optical isotope shifts. The main features of optical isotope shifts are summarized. (B.G.D.)

23889 EXCITATION OF HYDROGEN IN THE IMPULSE APPROXIMATION. Coleman, J. P.; McDowell, M. R. C. (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 87: 879-84(Apr. 1966).

The quantal impulse approximation is applied to the evaluation of electron and proton impact excitation cross sections for atomic hydrogen, a peaking approximation being made in evaluating the matrix elements. It is shown that results previously obtained in the quantal impulse approximation by Akerib and Borowitz are incorrect. The effect of the peaking approximation is to produce very poor results. (auth)

23890 EQUIVALENCE OF THE WAVE AND IMPACT PARAMETER TREATMENTS OF HIGH-ENERGY HEAVY PARTICLE COLLISIONS. Moiseiwitsch, B. L. (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 87: 885-8 (Apr. 1966).

It is shown that the nth-order Born approximation to the total cross section for the excitation of an atomic system by a high-energy heavy particle obtained by using the customary wave treatment is equivalent to that given by the method of impact parameters. (auth)

23891 $M_{IV,V}$ SPECTRA OF Eu. Williams, K. C. (Univ. of Leicester, Eng.). Proc. Phys. Soc. (London) 87: 983-8(Apr. 1966).

The M_{IV} and M_V absorption spectra of Eu in the form of the oxide and fluoride were studied in detail. The fluoride spectrum was similar to that reported by Zandy but two types of spectra were observed with the oxide absorbers. One was the same as the fluoride spectrum but the second type was shown to be due to partially reduced absorbers consisting of metallic Eu and Eu_2O_3. Evidence is presented and discussed which indicates that nearly all the $M_{IV,V}$ absorption is due to transitions of electrons into the incomplete 4f shell and that practically no "edge" absorption occurs. (auth)

23892 GROUP THEORY AND THE HYDROGEN ATOM. I. Bander, M.; Itzykson, C. (Stanford Univ., Calif.). Rev. Mod. Phys., 38: 330-45(Apr. 1966).

The internal 0(4) symmetry group of the nonrelativistic hydrogen atom is discussed and used to relate the various approaches to the bound-state problems. A more general group 0(1,4) of transformations is shown to connect the various levels, which appear as basis vectors for a continuous set of unitary representations of this noncompact group. (auth)

23893 GROUP THEORY AND THE HYDROGEN ATOM. II. Bander, M.; Itzykson, C. (Stanford Univ., Calif.). Rev. Mod. Phys., 38: 346-58(Apr. 1966). (SLAC-PUB-141).

A previous work dealing with bound states in a Coulomb potential is extended to the case of scattering states. The symmetry of the problem under the Lorentz group 0(1,3) is used to construct wave functions. Harmonic analysis on two-sheeted hyperboloids is briefly discussed in arbitrary dimension. The set of scattering states for both an attractive and a repulsive potential is shown to provide a unitary representation of the group 0(1,4). (auth)

23894 ATOMIC ABSORPTION BY ELECTRON SPECTROSCOPY. Badareu, E.; Popescu, I.; Ghita, C.; Musa, G. (Physics Inst., Bucharest). Rev. Roum. Phys., 10: 785-98(1965).

Various photo-ionization spectra are investigated with the help of an alkali-vapor-filled thermionic diode operating in the space charge limited mode. The high sensitivity as well as the direct electric recording of absorption spectra render this device most typical for a new field which may be called "electron spectroscopy." (auth)

23895 SECONDARY EMISSION OF GERMANIUM UNDER BOMBARDMENT BY POTASSIUM IONS ALONG VARIOUS CRYSTALLOGRAPHIC DIRECTIONS. Abroyan, I. A.; Lavrov, V. P.; Titov, A. I. (M. I. Kalinin Polytechnic Inst., Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 7: 2557-60(May 1966).

Translated from Fiz. Tverd. Tela, 7: 3159-62(Nov. 1965).

A study was made of the secondary emission of a germanium single crystal as a function of the angle of incidence of potassium ions having energies up to 7 kev. The influence of the ordered distribution of atoms in the germanium lattice on the kinetic electron emission and ion-ion emission was investigated. (auth)

23896 SECONDARY EMISSION OF EXCITED CESIUM ATOMS DURING BOMBARDMENT OF MOLYBDENUM AND TANTALUM BY FAST CESIUM IONS. Veksler, V. I.; Tsipinyuk, B. A. (Lenin Tashkent State Univ.). Soviet Phys.-Solid State (Engl. Transl.), 7: 2725-9(May 1966).

Translated from Fiz. Tverd. Tela, 7: 3386-91(Nov. 1965).

On the basis of a method previously proposed (Veksler, Soviet Physics–Solid State, 5: 2003(1963)), a systematic study is given of secondary emission of excited cesium atoms, created in the bombardment of plane targets of polycrystalline molybdenum and tantalum by a beam of fast (800 to 2000 ev) positive cesium ions, for various angles of incidence of the initial ions relative to the target surface. The distribution $n(\varphi)$ of secondary excited atoms and their mean-square velocity as a function of the angle of flight φ of the secondary particle is found for a number of initial ion energies with an ion beam normally incident on the target surface ($\chi = 0°$). The distribution $n(\varphi)$ has a maximum in the direction opposite to the initial ion motion. It is found that the mean-square velocity of the excited cesium atoms changes very weakly within the range of initial ion energies studied. Both this fact and the deformation of the shape of the $n(\varphi)$ curves with a change in the initial ion energy are explained by assuming that the excited atoms are expelled by displaced atoms of the metal lattice. An explanation is proposed for the observed elongation of the $n(\varphi)$ curves in the direction $\varphi = 90°$ with a change from a molybdenum to a tantalum target, and also the deformation of the shape of the angular distribution with changing χ. This leads to some arguments suggesting that the microroughness of the target surface has a significant effect on the picture of excited atom emission. (auth)

23897 ON THE CONDUCTIVITY AND RECOMBINATION COEFFICIENT IN ARGON. Kozlov, G. I. (Krizhizhanovskii Inst.of Power Engineering, USSR). Teplofiz. Vysok. Temp., 3: 510-19(July-Aug. 1965). (In Russian).

The collision cross section of electrons with atoms of argon and helium and with molecules of nitrogen at energies below 0.5 ev was determined using the 2-beam radioprobing method. By modification of the conductivity of argon in rarefaction waves, the coefficients of electron-ion recombinations in argon were given. The value of the coefficients range from 10^{-9} to 5×10^{-9} cm^3/sec in the temperature range from 3000 to 1700°K and in the pressure range from 1 to 4 atm. (tr-auth)

23898 SYMMETRY OF THE HYDROGEN ATOM. Malkin, I. A.; Manko, V. I. (Moscow Inst. of Physics and Tech.). Yadern. Fiz., 3: 372-82(1966). (In Russian).

The symmetry of differential equations is discussed. It is shown that the symmetry group of the hydrogen atom is the noncompact group O_8 and that the whole discrete spectrum is one infinite—dimensional irreducible representation of this group. Since the group O_8 contains the group $\tilde{U}(3)$ the hydrogen atom states can be characterized by the $\tilde{U}(3)$ group quantum-numbers supercharge, hypercharge and isospin. All representations of $\tilde{U}(3)$, which can be realized on the solutions of the Coulomb problem, are constructed. It is shown that the symmetry group of the n-dimensional Laplace equation is the group O_{n+2}. (auth)

23899 THE ORTHO-($p\mu p$) MOLECULE AND MUON ABSORPTION IN LIQUID HYDROGEN. Kabir, P. K. (CERN, Geneva). Z. Phys., 191: 447-60(1966).

Muon absorption rates in atomic and molecular states of hydrogen are calculated taking account of all known effects other than electromagnetic radiative corrections, to an estimated accuracy of one percent. The measured molecular absorption rate is found to agree very well with the rate to be expected on the basis of muon-electron equivalence. (auth)

23900 PLASMA EFFECT IN AN IONIZED HELIUM LINE. Berg, H. F. (Technische Hochschule, Aachen). Z. Phys., 191: 503-7(1966). (In German).

According to two different theories the 4686 Å-line of ionized helium should be blue shifted by measurable amounts. In the attempt of a precision measurement of the effect under several different plasma conditions no displacement could be found within the experimental accuracy of ±0.3 Å. A previous measurement is discussed. (auth)

23901 ROTATIONAL STRUCTURE OF THE OSCILLATION SPECTRUM OF HYDROGEN AND DEUTERIUM MOLECULES. Knyazev, I. N. Zh. Prikl. Spektrosk., 3: No. 6, 510-15(1965). (In Russian).

The mechanism responsible for pulsed-laser action on rotational levels of H_2 and D_2 in which excitation during the initial stage of the pulse discharge occurs by direct electron impact from the ground state is analyzed. It is shown that in addition to the Franck-Condon principle, it is also necessary to take into account certain features of rotational level population associated with the conservation of the molecular rotational state excited by electron impact. The peculiarities of a laser rotational spectrum (preferential laser action on P(2) and P(3) lines of H_2 and D_2, respectively, the great difference in laser intensity of the P(2) and P(4) lines of H_2, laser oscillation solely on orthomodifications) are explained qualitatively on the basis of the proposed excitation mechanism. (ATD)

23902 ON THE STIMULATED RESONANCE RAMAN SCATTERING. Apanasevich, P. A.; Ordabaev, D. N. Zh. Prikl. Spektrosk., 4: 134-41(Feb. 1966). (In Russian).

A quantum mechanical theory of stimulated-resonance Raman scattering is given that takes into account the influence of the incident and scattered radiation of the state and properties of molecules. As a result the formulas are obtained describing amplification power of the scattered beam of radiation and absorption of the incident beam, conditions when stimulated Raman scattering causes amplification of the radiation are found, and the boundaries of application of the theory which does not take into account the influence of the radiation on substance properties are considered. (auth)

23903 VZAIMODEISTVIE NERAVNOVESNOGO IZLUCHENIYA S VESHCHESTVOM. (Interactions of Nonequilibrium Radiation With Materials). El'yashevich, M. A. (ed.). Minsk, Nauka i Tekhnika, 1965. 227p.

Fifteen articles on topics in spectroscopy and luminescence are included. Discussions are given on the classification of nonequilibrium radiation, nonequilibrium emission and absorption spectra in the study of molecules, interactions of nonequilibrium radiation with matter, radiative energy transfer, and nonlinear optical phenomena. Results of experimental studies of the electron states of multiatomic molecules using their nonequilibrium radiation are presented. (M.J.T.)

Cosmic Radiation

See also Elementary Particles and Radiations
Nuclear Properties and Reactions

Refer also to abstracts 23847 and 23865.

23904 (AD-624518) THE USE OF COSMIC RAYS TO STUDY PHYSICS IN THE RANGE 100-1000 Gev. Jones, Lawrence W. (Michigan Univ., Ann Arbor. Dept. of Physics). Oct. 1965. Contract Nonr-1224(23). 15p. CFSTI $1.00 cy, $0.50 mn.

Experimental techniques are proposed for using cosmic rays in the range 100 to 1000 Bev for the purpose of interaction studies. (M.O.W.)

23905 (AD-627416) SOLAR PROTONS AND MAGNETIC STORMS. Pieper, G. F.; Zmuda, A. J.; Bostrom, C. O. (Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.). July 1962. Contract NOw-62-0604-c. 73p. (TG-442). CFSTI $3.00 cy, $0.75 mn.

Satellite observation of solar cosmic rays in a low energy range is reported. Comparisons were made with other observations, and detailed data concerning the time dependence of these particle fluxes and their relation to solar, geomagnetic, and associated phenomena are discussed. These data make it possible to infer certain relations between the various events observed, and to propose a general picture for the sequence of such events. (TAB)

23906 (N-65-10044) DESIGN OF A NEUTRON MONITOR FOR MEASUREMENTS IN SPACE. Scientific Report No. 1. Lockwood, J. A.; Friling, L. A. (New Hampshire Univ., Durham). [1964]. Contract NASr-164. 73p. (NASA-CR-59403). CFSTI $3.00 cy, $0.75 mn.

A neutron monitor, consisting of an ^{3}He proportional counter encased in a polyethylene moderator that, in turn, is surrounded by charged particle counters, was constructed and tested. The efficiency of this neutron detector system is 2.0 counts/neutron/cm^2 for 14-Mev neutrons and 20 cts/n/cm^2 at thermal energies. The electronics system is designed to reject neutron events occurring within 200 μsec after a charged particle counter is triggered, thereby providing discrimination against neutron production in the detector. A ^{6}LiI scintillator encased in a plastic scintillator, which acts as both a moderator for the neutrons and a charged particle detector was also built and tested. (auth)

23907 (N-66-15620) AN ANALYSIS OF THE RELATION BETWEEN SOLAR RADIO EMISSION AND LARGE SOLAR COSMIC-RAY INCREASES. Shianta, Alexis (Texas Western Coll., El Paso. Schellenger Research Labs.). June 1965. 68p. (NASA-CR-69433). CFSTI $3.00 cy, $0.75 mn.

A statistical analysis was made on solar radio outbursts associated with large solar proton events. Specific criteria were established demonstrating that solar radio outbursts are indicative of these large solar cosmic-ray increases. In addition, investigations were made into false alarms, various time relations, mixed-frequency combinations, and possible determinations of the size of a solar proton event. From these studies, it was found that there is a good correlation between specific signal characteristics of solar r-f emission outbursts and large solar proton events. On decimeter wavelengths, these signal characteristics can be detected prior to the start of the PCA event. It was also found that the false alarms can be considerably reduced if characteristics are specified on a combination of fixed frequencies rather than on only one frequency. In addition, there is an indication of a relation between the area under the associated r-f signal and the size of a solar proton event. Both Gold's and Parker's model of the interplanetary fields offer an explanation for some of the basic findings of this analysis. The results of this analysis can serve as the basic criteria for an electronic system that may provide a warning for large solar proton events. Such a warning system would reduce the corpuscular radiation hazard to future space flights. (STAR)

23908 (UCRL-12210) LOW-ENERGY ATMOSPHERIC GAMMA-RAY SPECTRA AT HIGH ALTITUDES. Anderson, K. A.; Primbsch, J. H.; Chodil, G.; Jopson, R. C.; Mark, Hans; Swift, C. D. (Lawrence Radiation Lab., Univ. of California, Livermore). Dec. 9, 1964. Contract W-7405-eng-48. 22p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The atmosphere contains large fluxes of cosmic ray photons in equilibrium with primary particles. These photons probably originate as a by-product of high-energy showers. Previous measurements at 40 kev and above indicate that the photon flux decreases rapidly as the quantum energy increases. The present measurements cover the energy region from 5 to 45 kev. A turnover in the spectrum should occur roughly at 40 kev due to strong photoelectric absorption in the air. Scintillation counters, flown on balloons at several locations, were employed to detect the gamma rays. The altitudes attained ranged from 33,500 to 36,600 meters. It was found that the spectrum has a maximum between 30 to 40 kev, and that the observed photon flux decreases below that quantum energy. At maximum altitude and at the maximum of the spectrum, the observed flux is approximately 2×10^{-2} photons sec^{-1} kev^{-1} cm^{-2} ster^{-1}. Measurements were made with gamma-ray counters pointing both up and down. It was found that the flux observed in both directions is approximately the same. (auth)

23909 MULTIPLY CHARGED PRIMARY COSMIC RADIATION AT SOLAR MINIMUM, 1965. Balasubrahmanyan, V. K.; Hagge, D. E.; Ludwig, G. H.; McDonald, F. B. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 71: 1771-80(Apr. 1, 1966).

The primary cosmic-ray charge and energy spectra were obtained for helium through oxygen during the recent period when solar modulation effects were at a minimum. These spectra represent a synthesis of preliminary experimental results from cosmic-ray experiments flown on OGO 1, IMP 3, and high-altitude Skyhook balloon flights. The He energy spectrum is given from 35 to 750 Mev/nucleon. The energy spectra for lithium-oxygen covers the interval ~40-1200 Mev/nucleon. Integral flux values >1200 Mev are obtained for He through Ne. L/M ratios of 0.29 ± .07 at 100 Mev/nucleon and 0.30 ± .03 above 600 Mev/nucleon are found. The C/He ratio of 0.023 ± .005 at 100 Mev/nucleon is significantly less than the same integral ratio of 0.036 ± .004 above 600 Mev/nucleon, indicating the effects of ionization losses during propagation through the interstellar gas under the assumption of similar source spectra. (auth)

23910 27-DAY PERIODICITY IN OUTER ZONE TRAPPED ELECTRON INTENSITIES. Williams, Donald J. (Johns Hopkins Univ., Silver Spring, Md.). J. Geophys. Res., 71: 1815-26(Apr. 1, 1966).

Data from the polar orbiting satellite 1963 38C show the existence of a 27-day periodicity in the intensities of trapped, ≥280-kev and ≥1.2-Mev electrons for L ≥ 3.5. This effect is seen for the four sequential solar rotations commencing October 6, 1963. The trapped energetic electron intensities are observed to undergo two large increases every 27 days and are shown to be intimately linked with the passage of the recently observed interplanetary magnetic field sector boundaries. It is also shown that these electron intensity increases are triggered by variations in the parameter β, the ratio of the directed solar wind kinetic energy density to the interplanetary magnetic field energy density. Equivalently, large variations in the Alfvén Mach number M_A are shown to be responsible for these trapped electron variations. (auth)

23911 PERIODIC MODULATIONS OF THE ENERGETIC ELECTRON FLUXES IN THE DISTANT RADIATION ZONE. Lin, R. P.; Anderson, K. A. (Univ. of California, Berkeley). J. Geophys. Res., 71: 1827-35(Apr. 1, 1966).

Periodic modulations of the energetic (>45 kev) electron fluxes are observed throughout the distant radiation zone by Geiger counters aboard Imp 1 and 2. These modulations have periods from a few minutes to half an hour, and coherent trains of these modulations are observed lasting as long as several hours. The peak-to-valley ratios are often an order of magnitude or more, and the strongest and most persistent periodicity is about six minutes. The largest and most regular modulations occur in the skirt region near the 0300 local time meridian (LSEP = 120°). Modulations of somewhat reduced amplitude are observed in the geomagnetic tail, in the transition region, and near the bow shock. It is believed that these modulations of the electron fluxes are evidence for strong hydromagnetic wave activity throughout the distant radiation zone. These modulations increase in amplitude and extent with K_p. No such modulations are observed inside L = 8 except when the daily K_p sum is greater than 23. The fact that the periods of these modulations tend to be about six minutes suggests that a resonant effect is occurring in the magnetosphere or in the transition region. (auth)

23912 ACCELERATION OF ELECTRONS NEAR THE EARTH'S BOW SHOCK AND BEYOND. Fan, C. Y.; Gloeckler, G.; Simpson, J. A. (Univ. of Chicago). J. Geophys. Res., 71: 1837-56(Apr. 1, 1966).

Groups of electrons of energies >30 kev were observed in the earth's magnetosheath, at the earth's bow shock, and in a region extending out to several earth radii beyond the shock. These measurements were made with a gold-silicon surface barrier detector on board the Imp 1 satellite, in the period of Nov. 27, 1963, to Feb. 13, 1964. A comparison of these results with observations made with a Geiger-Müller counter (University of California) on the same satellite shows that both instruments were recording the same elec-

tron structures. Since the response characteristics of the two detector systems for counting electrons are different, it is possible to estimate the spectrums of the electrons in these groups or spikes by comparing the counting rates of the respective detectors for each spike. For an assumed inverse power integral spectrum, $F = F_0E^{-\gamma}$, the value of γ was determined and it is found that it varies from 2.5 to 4.5 over a wide range of intensities and locations in space. At times of enhanced solar wind velocity, having a 27-day recurrence, electron spikes were also observed out to ~200,000 km, which is near satellite apogee. To investigate the origin of the electrons in spikes found in the magnetosheath, at the bow shock, and beyond the shock to distances of several earth radii, the temporal variation and energy spectra of the electrons in the outer radiation belt, but near the magnetospheric boundary, also were analyzed. It was found that the hardening in the energy spectrum of the trapped electrons in the radiation belt follows closely the compression of the boundary of the magnetosphere controlled by the strength of the solar wind. However, this change in spectrum was not observed for the electrons in the spikes. For this reason it is argued that the spikes are not groups of electrons escaping from the outer radiation belt, but rather are locally accelerated electrons. The Fermi acceleration mechanism proposed by Jokipii and Davis is discussed. (auth)

23913 VIOLATION OF THE SECOND AND THIRD ADIABATIC INVARIANTS. **Haerendel, G. (California Inst. of Tech., Pasadena). J. Geophys. Res., 71: 1857-68 (Apr. 1, 1966).**

The change of the mirror points of trapped particles under displacements of the guiding centers across the lines of force is studied in a dipole field with small-amplitude perturbations whose periods are of the order of the particles' drift period. It is demonstrated that there is no general principle that would cause the constancy of the second adiabatic invariant to an order higher than that of the third invariant. The diffusion of particles, owing to many random disturbances, is anisotropic, but only in the equatorial plane clearly one-dimensional. For higher-latitude mirror points, the diffusion along the lines of force cannot be neglected, though the direction of maximum diffusion coefficient is essentially across field lines, being somewhat inclined with respect to lines of constant latitude. The degree of anisotropy depends on the relative importance of the two main components into which the perturbation is resolved. It is argued that the observed proton distribution in the outer belt can be explained only by a superposition of a diffusion across the lines of force, which occurs with constant μ, the magnetic moment invariant, and a process that mixes particles along the lines of force at about constant energy and thus violates μ. (auth)

23914 THE VARIATION OF THE BAROMETRIC COEFFICIENT OF THE LEEDS NEUTRON MONITOR DURING THE SOLAR CYCLE 1954–1965. **Griffiths, W. K.; Hatton, C. J.; Ryder, P.; Harman, C. V. (Leeds Univ., Eng.). J. Geophys. Res., 71: 1895-8(Apr. 1, 1966).**

The barometric coefficient of the Leeds neutron monitor was determined by the method of successive differences suggested by Lapointe and Rose. The coefficient is shown to have a variation during the eleven-year cycle such that it has a value about 6% larger at solar minimum than at solar maximum. The need to use both the correct value of the barometric coefficient and the experimentally determined mean station pressure is discussed. (auth)

23915 INITIAL PHASE OF THE PCA EVENTS AND COMPOSITIONS OF THE SOLAR COSMIC RADIATIONS. **Hakura, Yukio (Radio Research Lab., Tokyo). J. Radiat. Res. (Jap.), 12: 231-73(Sept. 1965).**

The onset patterns of the PCA relating to the solar subcosmic radiations are analyzed by the use of newly developed corrected geomagnetic coordinates. It is clarified that the initial phase of the PCA consists of at least three characteristic stages, which occur successively in different zones of the polar region: the first stage observed as a slightly enhanced ionization near the geomagnetic pole, the second stage as a sudden development of the PCA in the upper auroral zone, and the third in which the enhanced ionization develops gradually in the lower auroral zone to achieve a condition called the whole polar cap blackout. Throughout the first and the second stages, the solar protons are shown to be a sole ionizing radiation, so that the development patterns of the PCA in these stages illustrate the invasion process of the solar protons into the earth's upper atmosphere. On the other hand, the alpha-particles in the solar cosmic radiations play an important role in the formation of the lower border of the absorption area during the third stage of the PCA initial phase. A rigorous calculation of the maximum rigidities of the solar cosmic radiations capable of producing the PCA effect leads to an experimental relation of the particles' rigidity vs. geomagnetic latitude of their arrival. The relation may be used for testing the modified Störmer theory, as to the solar particles' invasion into the quiet-day geomagnetic field distorted by the compression of the ever-blowing solar wind. (auth)

23916 END TO THE COSMIC-RAY SPECTRUM. **Greisen, Kenneth (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 16: 748-50(Apr. 25, 1966).**

The primary cosmic ray spectrum is predicted to steepen abruptly above 10^{20} ev due to an intense thermal isotropic radiation. The existence of this radiation and the effects on the cosmic ray spectrum are discussed. Pair creation and photopion production by protons on photons are described with relation to the cosmic spectrum cutoff. (B.G.D.)

23917 THEORETICAL STUDY OF COSMIC NOISE ABSORPTION DUE TO SOLAR COSMIC RADIATION. **Adams, G. W.; Masley, A. J. (Douglas Aircraft Co., Inc., Santa Monica, Calif.). Planet. Space Sci., 14: 277-90 (Mar. 1966).**

Calculations were made of the riometer absorption caused by solar protons and α particles in monoenergetic intensities and in spectral distributions. These calculations are an improvement over previous works in four respects; the geomagnetic cutoffs considered, the ionospheric parameters used, the treatment of monoenergetic intensities of particles, and the consideration of different riometer frequencies. Good agreement between calculated absorption and measured absorption was obtained. The studies of monoenergetic intensities show that the most efficient energy for protons is a strong function of the riometer frequency, and is ~50 Mev for 30 Mc/s. The most effective, or dominant, energy during solar cosmic ray events is lower, due to the relative abundance of low-energy particles, and for 30 Mc/s is in the 10–25 Mev region for most events. The minimum detectable intensity for riometers is ~10 protons/cm^2-sec-ster for typical events at 30 Mc/s, although this frequency could detect a monoenergetic (50 Mev) intensity of <1/cm^2-sec-ster. It was also found that several solar cosmic ray events near solar minimum exhibited spectra which acted as monoenergetic intensities of 10–15 Mev protons. Curves relating absorption to particle intensity for different energies are shown, which permit a quick determination of particle intensities from riometer measurements during events. All the calculations discussed above were also carried out for α particles. In addition, it is shown that α particles in spectra act similarly to protons; the dominant terms are the total intensity and the spectral shape, while the species is relatively unimportant. Calculated absorption versus frequency profiles indicate that considerable spectral information can be obtained by multifrequency riometers. (auth)

23918 LOW-ENERGY PROTONS: AVERAGE FLUX IN INTERPLANETARY SPACE DURING THE LAST 100,000 YEARS. **Lal, D.; Venkatavaradan, V. S. (Tata Inst. of Fundamental Research, Bombay). Science, 151: 1381-4 (Mar. 18, 1966). (NYO-901-21).**

The radioactivity of aluminum-26 in two cores of Pacific sediments is an order of magnitude higher than was expected, as a result of its production by cosmic-ray interactions in the terrestrial environment. The higher activity can be explained only by postulating influx with extra-

terrestrial cosmic dust that had been exposed to significant flux of energetic particles capable of producing nuclear interactions. These particles may well be the "solar" cosmic rays that are sporadically accelerated by the sun during certain solar flares, since the steady galactic cosmic-ray flux is inadequate. The long-term average flux of low-energy protons in interplanetary space, required to yield the observed rate of influx of aluminum-26, is deduced on the basis of certain assumptions. (auth)

23919 COSMIC X-RAY SOURCES, GALACTIC AND EXTRAGALACTIC. Byram, E. T.; Chubb, T. A.; Friedman, H. (Naval Research Lab., Washington, D. C.). Science, 152: 66-71(Apr. 1, 1966).

Instruments carried aboard an Aerobee rocket in April 1965 provided evidence for x ray emission from the directions of the radio galaxies Cygnus A and M-87 and from the galactic supernova remnant Cassiopeia A. A survey of the Cygnus region revealed a marked decrease in the flux of x rays from Cygnus XR-1, which was identified in June 1964 as the second brightest object in the first Naval Research Laboratory list of x ray sources. The detection sensitivity was improved over previous surveys and several new sources were detected at lower flux levels. (auth)

23920 PERIODICAL FLUCTUATION STUDIES OF COSMIC-RAY DIURNAL VARIATIONS DURING THE QUIET SUN PERIOD. Kodama, Masahiro (Chalk River Nuclear Lab., Ont. Can.). Uchusen-Kenkyu, 10: 655-66(Dec. 1965).

Statistical studies of periodic fluctuation of cosmic-ray diurnal variations were performed, using neutron and meson component data obtained by the high-counting-rate cosmic-ray monitors in Deep River from May 1962 till October 1964 during the period of descending solar activity ending near the solar minimum. It is shown that a 27-day periodicity of the amplitude of the diurnal variation occasionally appears as well as periodicities of about 5 to 13 days. The relations of the fluctuations of these effects with some typical solar and terrestrial indices are examined in a search for a possible origin of the shorter periodicities. A possible connection with the K_p-index exists. (auth)

23921 REPORTS OF THE ALL-UNION CONFERENCE ON COSMIC-RAY PHYSICS, APATITY, USSR, AUGUST 24-31, 1964. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: Nos. 9 and 10, 1627-1961(Sept.-Oct. 1965). (In Russian). (CONF-640814).

Eighty-five papers are included. Separate abstracts were prepared for each paper. Additional papers presented at the conference will be published in Kosmicheskie Luchi, No. 8, 1966. (M.J.T.)

For abstracts of individual papers see: 23478-23482, 23811, 23847-23855, 23922-23987, 24023, 24024, 24213, and 24375.

23922 PHENOMENOLOGICAL PICTURE OF SECONDARY PARTICLE PRODUCTION IN NUCLEON INTERACTIONS AT HUNDREDS AND THOUSANDS OF Bev. Dobrotin, N. A.; Zelevinskaya, N. G.; Kotel'nikov, K. A.; Maksimenko, V. M.; Puchkov, V. S.; Slavatinskii, S. A.; Smorodin, Yu. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1627-30(Sept. 1965). (In Russian).

Experimental data on secondary-particle production by primary cosmic rays are reviewed. Results on the inelastic interaction cross section and the inelasticity are discussed. About 90% of the secondaries are pions. Two mechanisms for pion production are described: pion production as a result of formation and fast decay of meson clusters (fireballs) and through the excitation of nucleons to isobaric levels and their subsequent luminescence. The secondary-pion momentum distribution is satisfactorily represented by the Bose-Planck function, except for a high-energy tail, which is ascribed to the decay of highly excited isobaric states. The energy-spectrum indices for atmospheric production of high-energy photons, due to pion decay, and of nuclear-active particles are found to be nearly the same, indicating that the energies of the high-energy pions are proportional to the energies of the primaries producing them. (M.J.T.)

23923 THEORETICAL ANALYSIS OF THE INTERACTION OF ELEMENTARY PARTICLES WITH ATOMIC NUCLEI IN THE 10 TO 1000-Bev ENERGY REGION. Barashenkov, V. S.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1631-3(Sept. 1965). (In Russian).

Production multiplicities and energy, angular, and transverse momentum distributions of shower particles produced in 27-3500 Bev collisions of nucleons with ^{12}C, ^{27}Al, and ^{70}Ga nuclei were calculated, and the results are compared with cosmic ray observations. The development of the intranuclear cascades was calculated by methods previously employed at accelerator energies. It was assumed that 80% of the secondaries produced in each inelastic interaction with a nuclear nucleon are pions and 20% are heavy particles and that the multiplicity and the energy and angular distributions of the secondaries depend only on the energy of the colliding particles. The inelastic scattering was calculated with the optical model. Satisfactory agreement is shown with the experimental data. Poor agreement with accurate angular distribution data is ascribed to systematic energy errors in nuclear emulsion data and to neglect of the exceptional role of nascent nucleons in the elementary act. A qualitative explanation for the bimodality of the angular distribution of shower particles in the log tan θ scale is found in the bimodality of the angular distribution of the particles produced in elementary acts within the nucleus. (M.J.T.)

23924 FUNDAMENTAL CHARACTERISTICS OF INELASTIC INTERACTIONS AT HIGH ENERGIES. Barashenkov, F. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1634-9(Sept. 1965). (In Russian).

Experimental data on high-energy inelastic interactions are reviewed in order to clarify the distinction between experimental facts and the theoretical models used to analyze them. Discussions are given of the composition of the secondary particles; the fact that the kinetic energy of the secondaries is practically independent of the nature of the primary and secondary particles; the variation of the fraction of heavy secondary particles with the primary energy; the energy dependence of the average multiplicity, the average inelasticity, the kinetic-energy distribution of secondary pions, and the average secondary-pion energy; the angular distributions of secondaries and the fireball and peripheral-collision mechanisms. Two types of inelastic interactions at accelerator energies are distinguished, differing in four-momentum transfer, inelasticity, and angular distributions. The success of statistical theories which take into account only the single N^*_{33} π-N resonance is discussed. (M.J.T.)

23925 ANGULAR DISTRIBUTION OF SECONDARIES IN ELEMENTARY MULTIPLE PRODUCTION EVENTS AT HIGH ENERGIES. Zelevinskaya, N. G.; Maksimenko, V. M.; Slavatinskii, S. A.; Sokolovskii, V. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1640-3(Sept. 1965). (In Russian).

The angular distributions of secondaries from nonsymmetric showers are calculated in terms of the difference between the numbers of forward and backward secondaries, assuming that all the secondaries are ultrarelativistic pions and that the probability for a given momentum distribution is proportional to the corresponding volume of phase space, and taking into account the laws of conservation of energy-momentum and charge. Results are presented and compared with the observed distributions for events of multiplicity 4 and greater. More highly asymmetric events are observed than predicted by the calculation, showing that statistical factors do not account for the asymmetry. The necessity of taking asymmetry into account when investigating the energy dependence of multiple production processes is shown. For instance, the observed apparent energy dependence of the inelasticity can be accounted for in terms of an energy-independent inelasticity and an asymmetric multiple production process. (M.J.T.)

23926 INFLUENCE OF ERRORS IN DETERMINING THE PRIMARY PARTICLE ENERGY ON THE RESULTS OF

MEASUREMENTS OF DIFFERENT CHARACTERISTICS OF NUCLEAR INTERACTIONS IN COSMIC RAYS. Murzin, V. S. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1644-7(Sept. 1965). (In Russian).

Unbiased statistical errors in the measurement of the energies of individual primary particles lead to biased errors in the determination of different characteristics of nuclear interactions in cosmic rays because of the nonlinear energy dependence of these characteristics and the power-law energy spectrum of the primaries. This effect is calculated in the determination of the energy spectrum of the primaries and the energy dependences of the inelasticity and multiplicity of nucleon-nucleon interactions, assuming that the experimental error in the logarithm of the primary energy is normally distributed. The experimental error in the determination of primary energies by the method of Castagnoli is estimated, and experimental data on the primary energy spectrum and the energy dependences of the inelasticity and multiplicity are discussed. The experimental data are found to be consistent with an energy independent inelasticity and a multiplicity proportional to the fourth root of the energy. (ATD)

23927 CHARACTERISTICS OF INTERACTIONS THAT GIVE RISE TO LARGE IONIZATION BURSTS. Babayan, Kh. P.; Grigorov, N. L.; Tret'yakova, Ch. A.; Shestoperov, V. Ya. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1648-51(Sept. 1965). (In Russian).

Nuclear interactions giving rise to large ionization bursts were studied. The electron-photon component, the energy transferred to neutral pions, and the energy retained by the primary or transferred to charged pions were measured with an array of ionization chambers and ionization calorimeters. A total of 676 bursts of energy over 1.4×10^{11} ev were recorded at 3200 m above sea level. The distribution of the fraction of the primary energy transferred to neutral pions is discussed. Twelve showers in which the energy transferred to neutral pions exceeded 2×10^{12} ev were investigated with the controlled nuclear emulsion technique, and results are presented. (M.J.T.)

23928 INVESTIGATION OF INTERACTIONS OF PARTICLES WITH ENERGIES OF THE ORDER OF 1000 Bev BY THE IONIZATION CALORIMETER TECHNIQUE. Babayan, Kh. P.; Grigorov, N. L.; Mamidzhanyan, E. A.; Sobinyakov, V. A.; Shestoperov, V. Ya. (Moscow State Univ. Inst. of Physics, State Committee on Use of Atomic Energy, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1652-5(Sept. 1965). (In Russian).

The energy spectrum of single nuclear-active particles at 3200 m above sea level was determined using a 10-m^2 ionization calorimeter. A hodoscope consisting of several G-M, scintillation, and Cherenkov counters, located up to 10 m from the calorimeter, recorded the showers accompanying the nuclear-active particles. Events were selected in which a single nuclear-active particle traversed the ionization calorimeter unaccompanied by a shower of more than 10^3 particles; 109 such events were observed in which the energy of the nuclear-active particle exceeded 5×10^{11} ev. The count rate, 0.32 particles/m^2/sterad/hr, was independent of the presence of a graphite absorber. The exponent in the integral energy spectrum of a single nuclear-active particle in the atmosphere was found to be ~2.5 for energies between 5×10^{11} and 10^{13} ev—much greater than that in the energy spectrum of primary cosmic rays at the top of the atmosphere, suggesting an energy dependence of the interaction mean free path. (M.J.T.)

23929 SOME PROBLEMS AND POSSIBILITIES RELATING TO INVESTIGATION OF COSMIC RAYS IN THE 100- TO 10,000-Bev RANGE. Grigorov, N. L.; Rapoport, I. D.; Savenko, I. A.; Skuridin, G. A.; Shestoperov, V. Ya. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1656-63(Sept. 1965). (In Russian).

Data on the energy spectrum and absorption and interaction mean free paths of nuclear-active cosmic-ray particles with energies from 10^{11} to 10^{13} ev are reviewed. The data are discordant, and part of this discordance is traced to neglect of the fluctuation of the fraction of the primary energy that is transferred to neutral pions in an elementary interaction event. There is evidence that the absorption and interaction mean free paths are not energy independent. (M.J.T.)

23930 INVESTIGATION OF THE INELASTICITY IN INTERACTIONS OF PARTICLES WITH CARBON NUCLEI. Azimov, S. A.; Abdullaev, R. S.; Polyak, Yu. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1664-6(Sept. 1965). (In Russian).

The average inelasticity of interactions of nuclear-active cosmic-ray particles with carbon nuclei was measured by means of an ionization calorimeter consisting of graphite slabs and associated ionization chambers. The total thickness of graphite amounted to about 5 nuclear interaction mean free paths. Cosmic particles unaccompanied by electron-photon showers and interacting in the first graphite slab were selected by counter trays. The data for 70 nuclear-active particles with energies above 100 Bev were averaged and are presented as a plot of relative energy transferred versus depth in the ionization calorimeter. Theoretical curves calculated for different assumed values of the inelasticity are given on the same plot. The experimental points lie between the theoretical curves for inelasticities 0.5 and 0.7. (ATD)

23931 PRODUCTION OF Λ^0, K^0_1 AND $\Sigma^\pm$ PARTICLES IN INTERACTIONS OF COSMIC RAYS WITH CARBON, COPPER, AND LEAD NUCLEI. Apshev, S. Zh.; Dadov, A. M.; Sakvarelidze, I. I.; Nakov, R. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1667-8(Sept. 1965). (In Russian).

The relative production rates in carbon, copper, and lead targets of hyperons and K mesons by cosmic particles accompanying penetrating showers were determined with the aid of a double Wilson chamber in an 8000-Oe magnetic field. The target was mounted between the two sections of the double Wilson chamber, and the following decay processes were detected $\Lambda^0 \rightarrow p + \pi^-$, $K^0_1 \rightarrow \pi^+ + \pi^-$, $\Sigma^\pm \rightarrow \pi^\pm + N$. In a total of 2940 penetrating showers there were observed 54 unstable particles. The numbers of unstable particles produced in the different targets are consistent with the assumption that the cross section is proportional to the two-thirds power of the atomic weight. (ATD)

23932 INELASTIC INTERACTIONS AT ULTRAHIGH ENERGIES. Matinyan, S. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1670-1(Sept. 1965). (In Russian).

Qualitative conclusions are drawn concerning multiple production in ultrahigh-energy collisions, assuming that the mass of the nonbaryonic object transferred between the colliding particles is small compared with the energy of the colliding particles. It is found that two jets are formed, each consisting of several groups of particles (resonances or fireballs), which move in the cms nearly in the direction of motion of the colliding particles. The momenta of the particles vary widely in magnitude but nearly coincide in direction. The inelasticity is large when isobars are formed and small when they are not. In the limit of very high energies, a correlation between the inelasticity and the presence of fireballs has no significance. The average multiplicity in π-N collisions exceeds that in N-N collisions. The relative number of secondaries other than pions is not energy dependent. A relation among the momenta of the particles of a single group is shown. (M.J.T.)

23933 ANGULAR DEPENDENCE OF THE NEUTRON-PRODUCING CHARGED COMPONENT OF COSMIC RAYS. Bel'skii, S. A.; Romanov, A. M. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1672-5(Sept. 1965). (In Russian).

The dependence on zenith angle of the intensity of the charged neutron-producing component of the cosmic rays was measured. The charged cosmic particles were recorded with a telescope counter. The neutrons produced in cylindrical absorbers of Pb, Cu, or Al were moderated in two cylindrical shells of paraffin and detected by a circle of boron-containing counters. Neutrons detected during 180 μ following passage of a charged particle were recorded. The apparatus was mounted on a rotating platform at an atmospheric depth of 1030 g/cm^2. No azimuth dependence

was detected. The intensity of the charged neutron-producing component decreased more rapidly with increasing zenith angle for zenith angles less than 60° than did that of the general charged component; for zenith angles greater than 60° the neutron-producing component decreased less rapidly than the general charged component. The relative counting rates with the different absorbers indicated that the average cross section for neutron production by charged cosmic-ray particles is proportional to the four-thirds power of the absorber mass number. (M.J.T.)

23934 INVESTIGATIONS OF FLUCTUATIONS IN THE DEVELOPMENT OF EXTENSIVE AIR SHOWERS WITH A FIXED TOTAL NUMBER OF CHARGED PARTICLES AND A FIXED TOTAL NUMBER OF MUONS. **Vernov, S. N.; Khristiansen, G. B.; Abrosimov, A. T.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1676-81(Sept. 1965). (In Russian).**

The simultaneous distribution of total number N of charged particles, total number M of muons, and age parameter S in extensive air showers were investigated. Showers were selected for which the zenith angle of the axis was less than 30°. M was determined from the number of muons recorded by the muon detector and the perpendicular distance of the muon detector from the shower axis with the aid of the known lateral distribution of muons. The relative error in determining M did not exceed 35%. The error in determining S was estimated to be 0.02 by processing artificial showers of known age, calculated by Monte Carlo methods. The data presented were derived from some 300 showers with total numbers of charged particles ranging from 10^5 to 4×10^6. Histograms are given showing the distribution of showers with respect to N with fixed M, M with fixed N, S with fixed N, and S with fixed M, and scatter plots are given for N versus S with fixed M and for M versus S with fixed N. The correlation coefficient of S with M for fixed N ranged between 0.62 and 0.72; the correlation coefficient of S with N for fixed M was −0.67. (ATD)

23935 STRUCTURE OF THE CENTRAL REGION OF A MUON SHOWER AT 40 m.w.e. **Vernov, S. N.; Khrenov, B. A.; Khristiansen, G. B. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1682-5(Sept. 1965). (In Russian).**

The structure of the central regions of muon showers accompanying extensive air showers was investigated. The muon flux at 40 mwe underground was found to be proportional to r^n, where r is the distance from the shower axis and $n = \frac{1}{2}$ for 7 m < r < 15 m and r = 1 for 15 m < r < 100 m; it was not possible to obtain the lateral distribution for r < 7 m because of the errors in determining r. The ratio of the numbers of counters triggered in the two halves of the muon detector and the probability for triggering neighboring counters were subjected to statistical analysis, and after correction was made for Poisson fluctuations there remained evidence that there exist in the center of the muon shower groups of associated muons with diameters from 2 to 3 m which are capable either of contracting into narrow groups with diameters less than 30 cm or of producing secondary showers. (ATD)

23936 ON FLUCTUATIONS IN THE LATERAL DISTRIBUTION OF MUONS IN EXTENSIVE AIR SHOWERS. **Aglamazov, V. A.; Burduli, A. V.; Gedevanishvili, L. D.; Kokhodze, L. Sh.; Ponezhev, M. Kh.; Sakvarelidze, I. I.; Khazaradze, N. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1686-9(Sept. 1965). (In Russian).**

The lateral distribution of penetrating particles accompanying extensive air showers was studied. The showers were detected by scintillation counters, and the position and direction of the shower axis were determined with the aid of six trays of Geiger counters. The penetrating-particle detector was located 200 mwe below the surface assembly and comprised six systems of two trays of 15 counters each, the two trays of each system being separated by 15 cm of lead. Data on over 10^4 showers with total number of particles from 5×10^4 to 5×10^6 are tabulated. The lateral distribution of penetrating particles was found in good agreement with previous results. Many more cases were observed in which two or more penetrating particles were recorded in a single shower than can be accounted for by random fluctuations. It is concluded that correlated groups of muons occur in the column of an extensive air shower, and it is suggested that there may be due to fluctuations in the elementary interaction of ultrahigh-energy nucleons. The relation between the frequency of coincidences in the penetrating-particle detector and the distance between the two counters involved was in good agreement with previous data. (M.J.T.)

23937 CALCULATION OF SOME CHARACTERISTICS OF EXTENSIVE AIR SHOWERS IN THE FRAMEWORK OF A MODEL OF A STRONGLY FLUCTUATING ELEMENTARY INTERACTION EVENT. **Nymmik, R. A.; Shestoperov, V. Ya. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1693-5(Sept. 1965). (In Russian).**

Characteristics of EAS are calculated assuming that the elementary interactions initiating the showers are of two kinds: pionization processes, in which pions are multiply produced with inelasticity of 0.29, and catastrophic events, in which the pionization process is followed by transfer of 70% of the primary energy to three charged or neutral pions. For the calculation it is assumed that the pionization probability is 0.7, the probability for a catastrophic event with production of hard charged pions is 0.2 and for one with production of hard neutral pions is 0.1, the absorption and interaction free paths of nuclear-active particles in the atmosphere are 120 and 83 g/cm^2, respectively, and the exponent in the primary energy spectrum is 1.7. Fluctuations in the location of the catastrophic events are taken into account. It is found that in 75% of the showers having 10^5 particles at sea level, over half the shower particles are due to catastrophic interactions. Taking account of fluctuations in the inelasticity and location of the initiating event reduces the estimated primary-proton energy. The ratio of the energy flux in the nuclear-active component to that in the electron-photon component is several times less than it would be if there were no inelasticity fluctuations. (M.J.T.)

23938 MONTE CARLO CALCULATIONS ON THE FLUCTUATIONS IN THE DEVELOPMENT OF EXTENSIVE AIR SHOWERS. **Atrashkevich, V. B.; Fomin, Yu. A.; Khristiansen, G. B. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1696-1701(Sept. 1965). (In Russian).**

Monte Carlo methods were used to calculate the fluctuations in EAS initiated by protons with fixed energy of the total number of electrons, the total number of high-energy muons, the age parameter, and the total energy flux in the electron-photon and nuclear-active components. Four different models were employed to describe the elementary high-energy-nucleon interaction; these models were selected to give an average inelasticity of 0.5 and differed in regard to the frequency and nature of very high energy secondaries. Monte Carlo methods were employed to determine the inelasticities and locations of all the interactions of the primary proton and the locations of the interactions of the high-energy secondary pions; the further development of the shower was calculated with conventional cascade equations in which the effect of pion decay was included. Calculations were performed for showers initiated by 10^{15}-, 10^{16}-, and 10^{17}-ev protons. The average values and dispersions of the number of electrons, the number of high-energy muons, the age parameter, the energy flux, and the correlation coefficient of the age parameter with the number of electrons are presented. These averages, dispersions, and correlation coefficients did not vary greatly with the model selected to represent the elementary nucleon interaction event. Formulas are given for calculating the corresponding quantities for showers initiated by nuclei on the assumption that the shower initiated by a nucleus of mass number A and energy E is the sum of A showers, each initiated by a nucleon of energy A/E. (M.J.T.)

23939 CALCULATION OF THE FLUCTUATIONS IN THE DEVELOPMENT OF CASCADE SHOWERS BY A

METHOD OF KOLMOGOROV. Kalmykov, N. N.; Chistyakov, V. P. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1702-5 (Sept. 1965). (In Russian).

The method of branching stochastic processes was used to calculate the average value and dispersion at different depths in an EAS initiated by a 10^{15}-ev primary proton of the fluxes of electrons, nuclear-active particles, and energy in the nuclear-active component. The basic equations of the method are presented. Calculations were performed for several different models of the initiating elementary interaction event, differing with respect to the number and nature of the very high energy secondaries. It was assumed throughout that pion-production proceeds according to Landau's theory and that the interaction mean free path of both nucleons and pions is 80 g/cm^2. The particle number fluctuations, even at maximum shower development, considerably exceed the Poisson fluctuations and are due mainly to the behavior of the initiating nucleon. The fluctuation at sea level of the number of high energy muons was also calculated. The fluctuation of the number of muons is much less than that of either the electron or the nuclear-active component, but it still exceeds the Poisson fluctuation. (ATD)

23940 CONCERNING THE ACCURACY OF THE EQUILIBRIUM PHOTON SPECTRUM AT ENERGIES CLOSE TO THE ENERGY OF THE PRIMARY ELECTRON. Sikora, D. I.; Shkoda-Ul'yanov, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1706-8(Sept. 1965). (In Russian).

The method of successive generations was used to calculate the equilibrium energy distribution of photons in electron-photon showers initiated in lead, copper, and water by 24-Mev electrons, and the results are compared with experimental data on the yield of photoneutrons in the bombardment of thick targets with electrons. Approximate agreement is obtained for energies near the primary electron energy only for materials with low atomic number. The discrepancy may be due to inaccurate values of the critical energies for photodisintegration. It is pointed out that the method of Krylov for solving Volterra integral equations, although it is very cumbersome, can be handled with computers and has the advantage that the accuracy can be continually improved without decreasing the integration step. (ATD)

23941 CONCERNING THE STABILITY OF THE SOLUTION OF THE INVERSE PROBLEM IN CASCADE THEORY. Astaf'ev, V. A.; Ivanenko, I. P. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1709-13(Sept. 1965). (In Russian).

The stability of methods developed previously for calculating the moments of the probability distributions for the elementary processes involved in a cascade is discussed by computing the errors in the evaluation of moments that arise from small errors in determining the cascade spectrum, using as an example the simple Furry cascade. The effects of different kinds of experimental error on the moments are considered. It is found that the solution of the inverse cascade problem is still not usable for deriving reliable information on the characteristics of the elementary interaction from experimental data on cosmic showers. (M.J.T.)

23942 ON TAKING IONIZATION LOSSES INTO ACCOUNT IN ELECTROMAGNETIC CASCADE THEORY. Bakhtadze, A. K.; Guzhavin, V. V.; Ivanenko, I. P. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1714-18(Sept. 1965). (In Russian).

Differential operators are presented which approximate the integral operator of electron-photon cascade theory. Such operators are presented for the four cases of Bethe-Heitler cross sections with complete screening or with correct screening and ionization losses either included or neglected; such an operator is also presented for the case of completely screened Bethe-Heitler cross sections but with the electron angular distribution taken into account. The solutions of the cascade problem obtained with the aid of these operators are discussed. In addition, the one-dimensional cascade equations are solved with the cross sections of Ter-Mikaelyan, which take account of polarization of the medium, and with the cross sections of Migdal, which are valid at very high energies. The use of the Ter-Mikaelyan cross sections removes the low-energy logarithmic divergence of cascade theory. The solutions of the very high energy cascade equations, using the Migdal cross sections at energies of 10^{18} to 10^{20} ev, differ from those of the cascade equations valid at lower energies mainly in scale: the cascade unit is replaced by a length proportional to the square root of the primary energy. (ATD)

23943 FLUCTUATION IN THE NUMBER OF PARTICLES IN AN ELECTROMAGNETIC SHOWER AT 110 Bev. Babaev, M. K.; Denikaev, R. Z.; Emel'yanov, Yu. A.; Zhukov, E. I.; Lukin, Yu. T.; Murzin, V. S.; Khomenko, G. S. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1719-21(Sept. 1965). (In Russian).

Electron-photon showers were investigated in an ionization calorimeter consisting of the following components in order from the top: 13 cm C, 3 cm Fe, 8 trays of ionization chambers each followed by 5 cm Fe, 2 trays of chambers with no absorber between, 1 cm Fe, 160 g/cm^2 C, 3 cm Pb, and two trays of chambers separated and followed by 2 cm Pb. Showers initiated by cosmic particles were regarded as electron-photon showers if they produced ionization in at least one of the two uppermost trays and no ionization in the two trays beneath the large carbon absorber. Of 334 electron-photon showers thus identified, 152 had energies between 100 and 200 Bev. The ionization versus depth curves for these showers were normalized to a primary energy of 110 Bev and averaged, and the average curve was compared with theoretical curves calculated for different assumed values of the radiation length in iron. Good agreement was obtained with the curve based on a radiation length of 12.6 g/cm^2. This value of the radiation length in iron was confirmed by comparing the observed depth of maximum shower development with calculated values. The fluctuation in the number of particles in the showers as a function of depth was compared with previous calculations. Good agreement was found at depths less than 23 radiation units, but at greater depths the observed fluctuations were much less than the calculated ones. (ATD)

23944 A NEW METHOD OF SOLVING THE NUCLEAR CASCADE EQUATION. Dedenko, L. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1722-4(Sept. 1965). (In Russian).

A new method is proposed for solving the cascade equations, and the integrodifferential equation for the energy-depth distribution of pions in the presence of a known nucleon flux is discussed as an example. Advantage is taken of the fact that pions of a given energy can be produced only by pions of considerably higher energy and by nucleons, so that the highest-energy pions arise only from the nucleons. The pion distribution function is therefore calculated for the highest energies with the cascade equation from which the integral describing pion production by pions is dropped; since the nucleon distribution is assumed known, this equation is a simple differential equation and can be easily solved. This high energy solution is then substituted into the pion-pion production integral and the resulting differential equation is solved for the pion distribution function for somewhat lower energies. This process is continued step by step until the distribution function is calculated for the lowest significant energies. This method is considerably more efficient than the method of successive generations and makes less demand on the memory of the computer. The relative efficiencies of the two methods are discussed in the language of information theory. (ATD)

23945 DEPENDENCE OF THE AVERAGE CHARACTERISTICS OF EXTENSIVE AIR SHOWERS ON THE MODEL DESCRIBING THE INTERACTION OF NUCLEONS WITH NUCLEI. Dedenko, L. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1725-7(Sept. 1965). (In Russian).

Many average characteristics of extensive air showers were calculated with the aid of a computer by a recently proposed method on the basis of four different models of the nucleon-nucleus interaction, and some results are presented and discussed. The interaction models on which the

calculations were based are the one-, two-, and many-fireball models and a model similar to that of Nymmik and Shestoperov. In all the models account is taken of the production of small numbers of exceptionally energetic pions by the isobar mechanism. The relation between the total number of particles in a shower at 5.6 km altitude and the primary energy depends only slightly on the interaction model, but the ratio of the number of showers with more than 10^6 particles at 12 km to the number of such showers at sea level is strongly model dependent. This ratio, however, also depends strongly on the composition and spectrum of the primary cosmic rays and on the interaction free path of the nuclear-active particles. The ratio of the depth integral of the total number of particles down to 3.3 km, which is proportional to the intensity of the Cherenkov flash at that altitude, to the primary energy is nearly independent of the interaction model, and this integral (or the Cherenkov flash) can be reliably employed to obtain data on the primary spectrum. Also briefly discussed are the number of high energy muons and the dependence of the energy in the electron-photon component on the total number of particles in the shower. (ATD)

23946 ON THE WIDTH OF THE MAXIMUM OF THE ALTITUDE DEPENDENCE CURVE FOR EXTENSIVE AIR SHOWERS. **Antonov, R. A.; Smorodin, Yu. A.; Tulinova, Z. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1728-30(Sept. 1965). (In Russian).**

Recent experimental data on the absolute incidence rates of extensive air showers of different strengths at different altitudes are used to construct isoincidence curves for rates of 10^{-9}, 10^{-10}, and 10^{-11} shower axes/cm^2/sec/sterad on a log N versus t plot (N is the number of particles in the shower and t is the depth in the atmosphere). Fluctuations in the shower development process are discussed and are found not more significant than the ~30% experimental error. The isoincidence curves are characterized by broad maxima, which extend nearly from 200 to 700 g/cm^2. Recent experimental data from a number of sources on the atmospheric depth of maximum development of extensive air showers of different energies are compared with theoretical calculations. The fact that the maximum development can occur at depths as small as 200 to 300 g/cm^2 shows that there must be interactions in which the energy is widely distributed among secondary particles. The energy dependence of the depth of maximum development, at least for energies up to 5×10^{15} ev, does not agree with the predictions of purely electromagnetic cascade theory but is consistent with those of nuclear cascade theory. (ATD)

23947 FLUCTUATIONS IN CASCADE SHOWER THEORY TAKING PARTICLE SCATTERING INTO ACCOUNT. **Gedalin, E. V. (Inst. of Physics, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1731-3(Sept. 1965). (In Russian).**

Equations are presented with which the moments of the numbers of electrons or photons in an electron-photon cascade can be calculated as functions of the depth, lateral position, and direction of motion of the particle. These equations were derived by methods that take account of scattering and are useful for the interpretation of extensive air showers. The approximation of infinite primary energy gives qualitatively incorrect results for dispersions and other characteristics of the distribution functions. In this approximation, for example, the dispersions of the particle numbers are independent of the direction of motion, whereas the actual dispersions are strongly angle dependent, as shown by results of calculations performed with the present equations and presented graphically. (ATD)

23948 ENERGY SPECTRA OF MUONIC AND ELECTRONIC NEUTRINOS IN THE ATMOSPHERE. **Volkova, L. V.; Zatsepin, G. T. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1740-2(Sept. 1965). (In Russian).**

The energy spectra and angular distributions of electronic and muonic neutrinos and antineutrinos in the atmosphere were calculated, and the results are presented graphically and in tabular form. For the calculations it was assumed that the muonic neutrinos arise from π-μ, K-μ, and μ-e decay, the electronic neutrinos arise from μ-e, $K^{\pm}$-eπ, and K_2^0-eπ decay, the ratio of the number of positive pions to the number of negative pions produced in the interaction of a proton with a nucleus is 1.56, there are produced 15% as many K^+ mesons as positive pions and 5% as many K^- mesons as negative pions, and that the production of K_0 and $\bar{K}_0$ mesons is analogous to that of K^+ and K^- mesons. Differences between the neutrino spectra presented are due to differences in the assumptions. (ATD)

23949 RESONANCE INTERACTION OF COSMIC-RAY NEUTRINOS WITH ELECTRONS. **Zheleznykh, I. M.; Zagrebin, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1746-8(Sept. 1965). (In Russian).**

The flux at 2 km underground of muons arising from the resonance interaction of cosmic electronic antineutrinos with atomic electrons through the intermediary of a hypothetical boson of mass M between 0.5 and 2 Bev was calculated. Fluxes were calculated for three different angular ranges and are presented graphically as functions of M. Curves are presented giving the muon fluxes due to electronic antineutrinos arising from muon decay, to electronic antineutrinos arising from K_{e3} decay, and to chi-neutrinos arising from pi-mu decay in accord with the theory of Marshak et al. involving a second intermediate boson of mass 20$^{\text{M}}$M. The muon flux does not vary greatly with depth; a change of 2 to 3 km in depth alters the muon flux by less than 20%. The largest calculated muon fluxes are of the order of 0.01 muons/m^2 day. (ATD)

23950 DIRECTIONAL AND ENERGY DISTRIBUTIONS OF MUONS PRODUCED UNDERGROUND BY NEUTRINOS. **Kuz'min, V. A.; Usanova, R. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1749-50(Sept. 1965). (In Russian).**

The energy and angular distributions of muons produced deep underground by cosmic neutrinos were calculated, and the results are presented graphically. The energy spectrum and angular distribution of high-energy atmospheric neutrinos given by Zatsepin and Kuz'min were employed in the calculations, and it was assumed that the cross section for muon production by interaction of neutrinos (antineutrinos) with protons (neutrons) is proportional to the neutrino energy for energies up to 100 Bev. The muon flux is maximum in the horizontal direction and the anisotropy increases with increasing muon energy and reaches 2 for 10-Bev muons. The calculated muon fluxes are of the order of 10^{-14} muons/cm^2/sec/sterad/Bev for 1 Bev muons and 10^{-15} muons/cm^2/sec/sterad/Bev for 10-Bev muons. (ATD)

23951 SOME REMARKS ON COSMIC-RAY ENERGY SPECTRA. **Rozental', I. L.; Shestakov, V. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1751-3(Sept. 1965). (In Russian).**

The errors in the experimentally determined power-law spectra of cosmic particles due to statistical errors in the measurement of the energies of individual particles are studied. The experimental energy spectrum $F'(E')$ is given in terms of the true spectrum $F(E)$ by $F'(E') = \int F(E) P(E,E')\, dE$, where $P(E,E')$ is the probability of finding the value E' for the energy of a particle whose true energy is E. The experimental spectrum F' E' corresponding to a true spectrum of the form $F(E) = AE^{-(\gamma+1)}$ is calculated with several different assumptions concerning the functions P, and in some cases formulas are derived for calculating the true spectrum from the experimental spectrum. The cases discussed include that in which P is constant when $(E - E')^2 < a^2$ and vanishes otherwise, and those in which $E - E'$ is Gaussianly distributed with a dispersion that depends on E. According to Landau's hydrodynamic theory of multiple production, the function P for the usual method of determining the energies of nuclear-active particles represents a Gaussian distribution of log E – log E' with a dispersion that depends on the multiplicity. It is shown that in this case an experimental value of the spectrum index γ as large as 3.5 may be found if the true value is 1.8. The proper choice of the energy intervals over which to average the data is discussed briefly. When determining

the spectral index γ the method of maximum likelihood and not that of least squares should be used. (ATD)

23952 CONCERNING THE DISTRIBUTION OF WEAK IONIZATION BURSTS PRODUCED UNDER A THICK ABSORBER BY HIGH-ENERGY MUONS. Gerasimova, N. M. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1754-6(Sept. 1965). (In Russian).

In determining the muon energy spectrum by the method of Alekseyev and Zatsepin with selection of small ionization bursts due only to direct pair production by muons, it is necessary to know the probability P(E,n,t) that n particles arise at depth t as a result of cascade multiplication of pairs produced by a muon of energy E. The approximate calculation of P is discussed on the basis of an integrodifferential equation given previously. With certain assumptions concerning P (including the assumption that it is independent of t) an asymptotic expression is derived which is valid for $N/n \ll 1$, where N is the number of particles at the maximum development of a shower initiated by an electron of energy E. It is shown, however, that this expression is accurate only at inaccessible energies. Two asymptotic expressions for P, valid for $n \lesssim N/m$ and $n \gg N/m$, respectively (E/m is the most probable energy of the electron or positron of a pair produced by a muon of energy E), are derived on the assumption that the particles at the depth of observation are all due to a single muon interaction. The asymptotic formula is not valid for $n \ll N/m$, and in this region P is best calculated numerically, using Monte Carlo techniques. The numerical calculations become more lengthy with increasing value of n, however, and for $n \gtrsim N/m$ the asymptotic formula gives a better result than any feasible Monte Carlo calculation. (ATD)

23953 ENERGY LOSS BY ULTRARELATIVISTIC MUONS IN ELECTROMAGNETIC INTERACTIONS. Erlykin, A. D. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1757-60 (Sept. 1965). (In Russian).

The energy loss in earth (Z = 10, A = 20; Z = 13, A = 26) and water of high-energy (10^{10}- to 10^{13}-ev) muons due to bremsstrahlung and pair production is calculated numerically, taking into account the well understood corrections but not radiative corrections or direct interactions with atomic electrons. The correction for the finite nuclear size and screening by the atomic electrons is discussed in detail; results for ^{208}Pb are compared with previous values. Screening by atomic electrons leads to considerable energy dependence of the bremsstrahlung loss. Taking account of high-energy pairs and pairs in which the electron and positron have greatly different energies leads to considerably greater pair-production energy loss than previously assumed. (M.J.T.)

23954 INVESTIGATION OF THE POLARIZATION OF COSMIC RAY MUONS AT 3860 METERS ABOVE SEA LEVEL. Kashkarov, L. L.; Gafurov, V. G.; Ivanenko, V. M.; Cherdyntsev, V. V. (Tadzhik State Univ., USSR. Physicotechnical Inst., Academy of Sciences, Tadzhik USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1761-4(Sept. 1965). (In Russian).

The polarization of cosmic ray muons was investigated at 3860 m above sea level at Pamir. Muons incident at zenith angles less than 20° were filtered through 110 g/cm^2 of lead (limiting muon energy 0.25 Bev) or 1100 g/cm^2 of earth and lead (limiting muon energy 2.5 Bev), and decay positrons from muons brought to rest in a lead absorber were counted separately in the upper and lower hemispheres. The ratio C of the number of upward-going to the number of downward-going decay positrons was found to be 1.20 ± 0.06 for the lower energy muons and 1.33 ± 0.12 for the higher energy muons. The muon polarization P was calculated with the formula $P = 3(C - 1)/a(C + 1)$ where $a = 0.91$ is a factor dependent on the positron counter geometry. The polarizations of the lower and higher energy muons were found to be 0.30 ± 0.08 and 0.47 ± 0.14, respectively. The polarization found for the lower energy muons is in satisfactory agreement with those found by other investigators at sea level, but the polarization found for the higher energy muons exceeds previous values by more than the experimental error. It is suggested that this discrepancy may be due to the presence of a larger fraction of muons of K-mesonic origin at the higher altitude. (M.J.T.)

23955 MUON PRODUCTION IN THE ATMOSPHERE AND THE ENERGY DEPENDENCE OF THE POSITIVE EXCESS. Volkova, L. V.; Zatsepin, G. T. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1765-8(Sept. 1965). (In Russian).

The muon positive excess and its energy dependence are very sensitive to the meson-production mechanism. These quantities were calculated on the basis of the isobar model of π- and K-meson production of Zatsepin. It was assumed that the number of primary neutrons is 13% of the number of primary protons, nuclear nucleons interact as free nucleons, the numbers of protons and neutrons at sea level are approximately equal, the nucleon absorption free path is 120 g/cm^2, pions are produced with a power law spectrum, the ratio of the number of positive to the number of negative pions produced by protons is equal to the ratio of the number of negative to the number of positive pions produced by neutrons, 15% as many K^+ mesons are produced as positive pions, and 5% as many K^- mesons are produced as negative pions. The theoretical muon positive excess at sea level was found to increase with increasing muon energy and to reach values for 4-Bev muons between 1.35 and 1.6, depending on the assumed fraction of primary nucleon interactions that involve charge exchange. The muon positive excess decreases slightly with increasing zenith angle of muon incidence. (ATD)

23956 HORIZONTAL FLUX OF MUONS WITH ENERGIES EXCEEDING 700 Bev. Arutyunyan, F. R.; Ispiryan, K. A.; Oganesyan, A. G. (Inst. of Physics, State Committee on the Uses of Atomic Energy, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1769-71(Sept. 1965). (In Russian).

The horizontal flux of high-energy cosmic muons was used to study the radiation produced by the uniform motion of a charged particle through a periodic laminated medium. The medium consisted of 300 sheets of paper. Cosmic muons entering from a solid angle of 0.29 sterad at zenith angles between 73 and 90° were selected by a counter telescope. Electrons were discouraged by absorbers, and spurious counts due to cosmic showers were eliminated by anticoincidence counters. Photons emitted in the backward direction by muons traversing the laminated medium passed through a chamber containing Xe, where they excited 35-kev x rays. The x rays were recorded with NaI:Tl crystals. An event was recorded when at least two x rays were detected simultaneously with the passage of a muon. Background was determined by recording events with a plastic shield between the laminated medium and the Xe chamber. In 5465 hr 77 events were recorded, of which nine are ascribed to background. Muons with energies above 700 Bev were detected, and the hypothesis that muons radiate when traversing a laminated medium is confirmed. (M.J.T.)

23957 INVESTIGATION OF LOW-ENERGY CHARGED PARTICLES WITH THE COSMOS 12, COSMOS 15, AND ELECTRON 2 SATELLITES. Vernov, S. N.; Mel'nikov, V. V.; Savenko, I. A.; Savin, B. I.; Shavrin, P. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1794-9(Oct. 1965). (In Russian).

Spherical electrostatic charged-particle analyzers carried by the Cosmos 12, Cosmos 15, and Electron 2 satellites are described. The charged particles traversing the analyzer were collected in a Faraday cup. The minimum global intensity that could be recorded was approximately $6 \times 10^6\ E_0^{-1}$ particles/cm^2/sec/kev. The analyzer on the Cosmos 12 was sequentially programmed to record 0.5-kev electrons or 1-kev electrons or ions, and that on the Cosmos 15 recorded 1-kev electrons or ions. The Electron 2 carried two analyzers, programmed to record charged particles of 0.1 to 10 kev. The fluxes of 1-kev charged particles observed with the Cosmos satellites were ordinarily near or below threshold. Steady fluxes up to 2×10^7 particles/cm^2/sec/kev were observed south

of New Zealand in the region of the maximum southern isochasm. It is suggested that an intensity increase over the equatorial Pacific observed on 27 Dec. may be associated with the solar flare of 24 Dec. The Electron-2 measurements revealed a broad fluctuating region near the earth of increased electron intensity. Electron intensities of 5×10^8 particles/cm^2/sec/kev at 0.2 kev and 5×10^7 particles/cm^2/sec/kev at 10 kev were observed in this region. Intensity increases were also sometimes observed near the apogee. (M.J.T.)

23958 MEASUREMENTS OF THE INTENSITY OF COSMIC RAYS IN THE STRATOSPHERE ABOVE ANTARCTICA. Vernov, S. N.; Charakhch'yan, A. N.; Babarykin, V. K.; Bayarevich, V. V.; Stozhkov, Yu. I.; Charakhch'yan, T. N. (Lebedev Inst. of Physics, Moscow. Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1805-6(Oct. 1965). (In Russian).

Simultaneous measurements of cosmic-ray intensities were carried out in the northern and southern hemispheres—at Murmansk and Mirnyi, respectively. The measurements were taken in atmospheric depths greater than 10 g/cm^2, allowing the penetration of primary protons with energies above 100 Mev. The intensity differences between the two stations are found to be related to the season of the year, not to the difference in the primary energy spectrum. Results of the average yearly cosmic-ray intensity for both stations and of the difference in intensity at the two stations for each season and averaged over the whole year are shown as functions of atmospheric depth. (M.J.T.)

23959 FUNDAMENTAL PROBLEMS IN COSMIC-RAY ASTROPHYSICS. Ginzburg, V. L.; Syrovatskii, S. I. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1819-24(Oct. 1965). (In Russian).

Literature on astrophysics of cosmic rays is reviewed. The questions of the origin and cosmological significance of cosmic rays are discussed. Cosmic-ray production as a mechanism for carrying off the energy released in stellar or galactic gravitational collapse is considered. There is convincing evidence that the energy density of cosmic rays is much less in metagalactic space than in the Galaxy. Thus most of the cosmic rays are of galactic origin. Primary cosmic electrons arise mainly from the direct acceleration of electrons rather than from meson decay. The stationary model of the origin of cosmic rays, according to which most cosmic rays originate in supernovae, has not encountered any difficulties but can not be regarded as proved. There is no convincing evidence that an explosion of the nucleus of the Galaxy occurred in the past 10^9 years; the explosions observed in M82 and NGC 5128 do not indicate that such explosions are probable in the Galaxy. It has been argued that, if all cosmic rays originated simultaneously, the relativistic particles would have travelled farther and encountered more interstellar matter than the low-energy particles and would therefore contain a larger fraction of light nuclei, whereas observational evidence indicates that the higher energy cosmic rays have a smaller fraction of light nuclei. This argument is not decisive, however, because the high-energy cosmic rays may have travelled through regions in which the density of interstellar matter is less than in those through which the low-energy cosmic rays passed. It may be possible soon to determine by studying meteorites whether the cosmic-ray intensity was significantly greater 10^8 years ago than now. (ATD)

23960 METEORITES AND THEIR USES IN COSMIC-RAY STUDIES. Lavrukhina, A. K. (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1838-42(Oct. 1965). (In Russian).

A review is given on the methods and results of studies of the identities and activities of radionuclides in various types of meteorites, performed to gain information on the integral fluxes, time variation, and intensity and energy spectra of cosmic rays in space. (M.J.T.)

23961 STUDIES OF COSMIC-RAY VARIATIONS BY MEANS OF THE EFFECTS FOUND IN ROCK METEORITES. Lavrukhina, A. K.; Rutkovskii, V. M.; Ibraev, T. A.; Yukina, L. V. (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1843-5(Oct. 1965). (In Russian).

Results of radiochemical studies of the Zaisan chondrite, which fell in Kazakhstan on Dec. 14, 1963, are reported. Activities of various isotopes found in this chondrite are presented and compared with values for other chondrites; possible reasons for the higher activities found in the Zaisan chondrite are discussed. In an attempt to gain a quantitative picture of the variation of the rate of formation of cosmogenic radioisotopes by primary and secondary cosmic radiation as a function of depth in the meteorite, the distributions of nuclear-active particles in iron meteorites with radii of 5, 40, and 100 cm are calculated. (M.J.T.)

23962 COMPOSITION AND ENERGY SPECTRUM OF THE PRIMARY COSMIC RAYS IN THE MODERATE-ENERGY REGION. Kurnosova, L. V.; Razorenov, L. A.; Fradkin, M. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1846-52(Oct. 1965). (In Russian).

Results of studies on the energy spectra and composition of the primary cosmic rays with energies from 10^8 to 10^{10} ev/nucleon are reviewed. The energy variations of the spectral index, of the ratio of light (Li, Be, B) to heavy nuclei, and of the ratio of heavy to medium-mass nuclei are described. The effects of solar activity and emission, interplanetary and terrestrial magnetic fields, and ionization losses on cosmic-ray fluxes are considered. The origin of the electron component and the composition of solar cosmic rays are discussed. (M.J.T.)

23963 PRELIMINARY RESULTS OF INVESTIGATIONS OF THE COSMIC-RAY NUCLEAR COMPONENT WITH THE COSMOS 12, COSMOS 15, AND ELECTRON 2 SATELLITES. Kurnosova, L. V.; Logachev, V. I.; Platonov, G. F.; Razorenov, L. A.; Sinitsina, V. G.; Suslov, A. A.; Fradkin, M. I. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1853-8(Oct. 1965). (In Russian).

The fluxes of the various groups of the nuclear component of the primary cosmic rays and their variations with solar activity in the IYQS were studied by the Electron 2 satellite. The detection equipment on Electron 2, consisting of a Cherenkov counter within the satellite and a Cherenkov-scintillation telescope outside the satellite, is described, and the response of the instruments to particles of various energies and atomic numbers is discussed. Preliminary results are compared with previous data. A strong negative correlation is indicated between solar activity and the intensity of the cosmic-ray nuclear component. (M.J.T.)

23964 PRELIMINARY DATA ON THE NUMBER OF ELECTRONS AND GAMMA RAYS IN THE PRIMARY COSMIC RADIATION WITH ENERGIES ≥3 Bev. Rubtsov, V. I. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSR, Ser. Fiz., 29: 1859-61(Oct. 1965). (In Russian).

Preliminary results of stratosphere flights undertaken to detect and measure the electron and photon components of the primary cosmic radiation are reported. The apparatus consisted of three plastic scintillators mounted in line, separated by lead sheets, and surrounded by Geiger counters. Coincidences between the last two scintillators were counted and separated into three classes according to the amplitude of the pulse in the first scintillator. Altitude versus counting rate curves are given for those double coincidences for which the pulse in the first scintillator corresponded to passage of less than 0.1, less than 3, and more than 3 relativistic particles. These curves are discussed in detail. It is found that, if there are primary electrons and photons with energies exceeding 3 Bev, their fluxes are less than 2% and 0.3%, respectively, of the primary proton flux. (ATD)

23965 MAGNETIC PARTICLE MOTION IN A DIPOLE EARTH FIELD. Dorman, L. I.; Okulov, Yu. I. (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1862-4(Oct. 1965). (In Russian).

Results of previous studies on the production cross section and the mass of the magnetic monopole are summarized. The motion of the magnetic monopole in the dipole field of the earth is shown to be much more complicated than found in previous works, where the monopoles are found to move along magnetic lines of force and thus impinge on the magnetic poles of the earth. The Hamilton-Jacobi method is used to demonstrate that only at the initial moment of time is motion along the force lines in the dipole field possible. The possibility of a circular trajectory is pointed out, and the calculated dependence of the kinetic energy on the distance from the earth is shown for a circular orbit. (M.J.T.)

23966 ELECTROMAGNETIC MECHANISM OF COSMIC-RAY ACCELERATION. **Glikman, L. G.; Kel'man, V. M.; Yakushev, E. M. (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1865-9(Oct. 1965). (In Russian).**

The relativistic equations of motion of a charged particle moving in the plane of antisymmetry of a varying axially symmetric magnetic field are solved for the case when the azimuthal component of the vector potential in the plane of antisymmetry has the form $f(r/(t-a))/r$, where f is an arbitrary function, r is the distance from the axis, t is the time, and a is a constant. Numerical solutions were computed for a field which alternately increases and decreases between finite limits and remains constant for a time at each limit. For the computations it was assumed that the field strength oscillates between 1.0×10^{-5} and 1.2×10^{-5} Oe with a period of 3.5×10^5 sec. Some of these solutions are presented graphically and are discussed. The computations show that the ratio of particle energy to field strength is not constant and that particles can be accelerated to high energies by variable magnetic fields which do not increase indefinitely in strength. (ATD)

23967 SEARCH FOR 10-Tev PHOTONS FROM LOCAL RADIOSOURCES. Chudakov, A. E.; Dadykin, V. L.; Zatsepin, V. I.; Nesterova, N. M. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1870-1(Oct. 1965). (In Russian).

Results of experimental attempts to find cosmic photons with energies $>10^8$ ev are summarized and found inconclusive. An experiment, performed in 1960–64 in Crimea, is described, in which the higher-energy photons were measured according to the excess of intensive air showers from the direction of cosmic radiosources over the intensity of showers from neighboring parts of the sky, using a narrow-angle telescope system. The accuracy of the measurements is discussed. Results were negative. The upper limit of the possible flux of photons with energies $>5 \times 10^{12}$ ev was found to be $5 \times 10^{-11}/cm^2/sec$ for the objects Cygnus A, Taurus A, Cassiopeia A, and Virgo A; for other objects, the limit was 2 to 4 times higher. Results from Taurus A show that the electrons in the Crab Nebula are not produced in nuclear interactions and are accelerated at least as efficiently as protons; thus these electrons are not secondary. Results also indicate that electrons in supernovae are accelerated preferentially to nuclei and that thus possibly supernovae are not a strong cosmic-ray source. (M.J.T.)

23968 ON THE ENERGY SPECTRA AND PROPERTIES OF THE PRIMARY SUPERHIGH-ENERGY COSMIC RADIATION. **Khristiansen, G. B. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1872-5(Oct. 1965). (In Russian).**

Experiments were carried out to measure the spectra of electron and muon EAS and the variations in the electron and muon fluxes. Results of these experiments, together with previous measurements, permit a picture of the energy spectrum and composition of the primary cosmic radiation of superhigh energies to be given. A graph of the energy spectrum of the primary radiation from 10^{15} to 10^{18} ev is shown. The representation of the spectrum by means of various spectral indices for the different energy ranges is discussed. The methods of analyzing the data and the causes of errors are explained. Possible mechanisms of generation and propagation of primary cosmic rays are considered in an attempt to explain the observed spectral shape. (M.J.T.)

23969 PRIMARY SUPERHIGH-ENERGY COSMIC RADIATION ACCORDING TO DATA ON EXTENSIVE ATMOSPHERIC SHOWERS. **Vernov, S. N.; Khristiansen, G. B.; Abrosimov, A. T.; Atrashkevich, V. B.; Belyaeva, I. F.; Kulikov, G. V.; Solov'eva, V. I.; Fomin, Yu. A.; Khrenov, B. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1876-80(Oct. 1965). (In Russian).**

The primary energy spectrum of cosmic rays is analyzed on the basis of data on the spectrum of EAS with respect to the number of high-energy muons and the EAS distribution over the electron number for a given muon number. Results of the electron and muon distributions are presented and are found to be in satisfactory agreement with theory. It is concluded that the composition of primary cosmic rays in the superhigh-energy region apparently does not differ significantly from the composition at low energies and that the spectral index is not constant but varies for the different energy regions. (M.J.T.)

23970 DATA ON THE 27-DAY VARIATION OF COSMIC-RAY INTENSITY IN THE STRATOSPHERE. **Bazilevskaya, G. A.; Charakhch'yan, T. N. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1888-90(Oct. 1965). (In Russian).**

Cosmic-ray intensity periodograms based on the preceding six months data on the maximum cosmic-ray intensity in the stratosphere over Moscow and the sea-level neutron intensity as recorded at Herstmanceaux or Deep River were constructed at monthly intervals beginning in 1957; some of these periodograms are presented and discussed. The 27-day period was apparent not only in 1957, but also in 1958 and throughout most of 1963, i.e., at times during which solar activity was near minimum. On many of the periodograms there were prominent maxima in both the stratosphere and the sea-level data corresponding to periods between 20 and 23 days, and some periodograms showed two maxima, one at 22 days and one at 30 days. The shape of the 22-day wave was the same in the stratosphere and the sea-level data, but the ratio of the amplitude of the 22-day wave in the stratosphere to that at sea level ranged from 5 for the period October 1958 to March 1959 to 1 for the period February 1950 to July 1959. (ATD)

23971 RELATION BETWEEN FORBUSH EFFECTS AND SOLAR FLARES. **Krymskii, G. F.; Shafer, G. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1891-3(Oct. 1965). (In Russian).**

The distributions in time and heliographic longitude of solar flares of importance 2 or higher during the 4 days preceding and the 2.5 days following the onsets of Forbush decreases were compared with theoretical distributions based on the assumption that the flares not associated with the Forbush effect are uniformly distributed. Best agreement was obtained with the distribution calculated on the assumption that the probability for a flare to produce a Forbush decrease is proportional to the seventh power of the cosine of its heliographic longitude and that the Forbush decrease is delayed by one to two days. The effective width of the disturbed region of interplanetary space responsible for Forbush effects is estimated to be approximately 60°. The delay between the onset of a Forbush decrease and the appearance of the flare that causes it appears to be greater for flares in the eastern hemisphere than for flares in the western hemisphere. The magnitude of a Forbush decrease depends strongly on the heliographic latitude of the flare that causes it when the flare is in the southern hemisphere, but not when the flare is in the northern hemisphere. There are two maxima during the year in the distribution of flares associated with Forbush decreases, suggesting that the angular width in the meridian plane of the disturbed region in interplanetary space is small. A relation was detected between the magnitude of a Forbush decrease and its delay after the appearance of the flare responsible for it, the larger decreases having the smaller delays. (ATD)

23972 INVESTIGATION OF COSMIC-RAY INTENSITY VARIATIONS DURING FORBUSH EFFECTS. Kolomeets, E. V.; Pivneva, V. T. (Kazakh State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1894-7(Oct. 1965). (In Russian).

The time variations of the horizontal component of the earth's magnetic field and the cosmic-ray intensity during 7 magnetic storms accompanied by Forbush decreases are compared, and the results are discussed briefly. Curves are presented for the storms of October 20 to November 3, 1958, and March 29 to April 15, 1960. The cosmic-ray and horizontal-magnetic-field intensities correlate rather well. At the time of minimum horizontal field intensity, however, there is a small maximum in the cosmic-ray intensity; this is ascribed to a shift of the rigidity threshold. During recovery the small-amplitude variations of cosmic-ray intensity observed at high-latitude stations correlate negatively with those of the horizontal-magnetic-field intensity. The observations are consistent with the current hypothesis that the changes of cosmic-ray and horizontal-magnetic-field intensities are due to the same corpuscular streams. (ATD)

23973 MODULATIONS OF THE SOLAR DAILY EFFECTS AND THE POSSIBILITY OF SEPARATING COSMIC-RAY INTENSITY VARIATIONS ACCORDING TO SIDEREAL TIME. Dorman, L. I.; Inozemtseva, O. I.; Mazaryuk, E. A.; Solov'eva, Z. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1898-1901(Oct. 1965). (In Russian).

An attempt is made to detect the sidereal daily variation during the period of decay of solar activity from 1960 to 1964, using data of crossed telescopes and neutron monitors from Moscow and some stations of the world network. It is assumed that the solar daily variation is subjected only to amplitude modulation and the phase modulation is negligible. Expressions are presented for the amplitude and phase of the spurious sidereal variation, and values for the spurious and actual sidereal variation are thus obtained. Results of harmonic analysis of the daily variations are shown and discussed. (M.J.T.)

23974 SECULAR VARIATIONS OF COSMIC RAYS IN THE STRATOSPHERE DURING THE PERIOD FROM 1962 TO 1964. Ageshin, P. N.; Kolomeets, E. V.; Charakhch'yan, A. N.; Charakhch'yan, T. N. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1902-3(Oct. 1965). (In Russian).

Results of the continuation of measurements started in July 1957 are presented for the secular variations of cosmic-ray intensity in the stratosphere from Jan. 1962 to Apr. 1964. The average monthly values of the particle number for data from Murmansk, Moscow, Alma-Ata, and Mirnyi are shown. Results for the average monthly cosmic-ray intensities at geomagnetic lat 51° are correlated with the relative sunspot numbers for 1957 to 1964. Fluxes of primary cosmic rays for three energy ranges, calculated from the data, are given for Apr. 1958 to Dec. 1963. (M.J.T.)

23975 ASYMMETRY IN COSMIC-RAY VARIATIONS. Chirkov, N. P.; Kuz'min, A. I. (Inst. of Cosmophysics and Aeronomics, Academy of Sciences, Siberian SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1904-6(Oct. 1965). (In Russian).

Studies of the Forbush-effect and secular variations in the cosmic-ray intensity and of the latitude dependence of their amplitudes are continued, using data from the world network from 1958 to 1961. The averaged amplitudes of the Forbush variations are presented as functions of geomagnetic latitude for the four years; the amplitude variations are attributed to changes in the dimensions of the cosmic-ray modulating region. Average monthly values of neutron and meson intensities are correlated with sunspot numbers and geomagnetic activity for various stations from 1957 to 1964. (M.J.T.)

23976 INVESTIGATION OF THE ENERGY SPECTRA OF THE INCREASED PARTICLE FLUX APPEARING WITH DECREASING SOLAR ACTIVITY. Bikineev, A. M.; Kolomeets, E. V.; Likhoded, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1907-8(Oct. 1965). (In Russian).

Calculations of the energy spectra of cosmic-ray variations and the changes in the spectra with decreasing solar activity are carried out, using data obtained in the stratosphere in the USSR and the USA for October to December of the period 1958 to 1963. The calculation of the spectra is based on the dependence of the flux increase on the hardness of the cut-off. The flux increases of the particles as functions of energy are presented for magnetically quiet days and for magnetically perturbed days when there were no magnetic storms or Forbush decreases but when the horizontal component of the earth's magnetic field changed from 20 to 30 γ. Values of the spectral index are given by year for magnetically quiet and disturbed days. (M.J.T.)

23977 PROBLEMS IN MEASURING THE NEUTRON ALBEDO AND CERTAIN EXPERIMENTAL RESULTS. Sokolov, V. D. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1913-15(Oct. 1965). (In Russian).

Difficulties in determining the neutron albedo due to the necessity of measuring neutron fluxes over a wide range of energies and to problems in identifying the albedo neutrons because of contamination from secondary neutrons produced in the rocket or satellite carrying the detector are described. Experiments were carried out at Yakutsk in 1960–62 to measure the slow-neutron albedo using balloons and spherical detectors at high altitudes. The variation with depth from the top of the atmosphere of the count rate of neutron counters shielded from the lower side with hemispheres of Sn and Cd is shown, and the resulting calculated altitude dependence of the neutron flux at the Cd cutoff for Sn and Cd shielding is given. (M.J.T.)

23978 THE 27-DAY VARIATIONS OF COSMIC-RAY ANISOTROPY ACCORDING TO OBSERVATIONS OF THE NEUTRON COMPONENT ON MOUNTAIN STATIONS OF THE GLOBAL NETWORK. Alaniya, M. V.; Dorman, L. I.; Shatashvili, L. Kh. (Inst. of Geophysics, Academy of Sciences, Georgian SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1916-19(Oct. 1965). (In Russian).

The 27-day changes of the solar-daily variation were examined for the period July 1957 to June 1958, using data of the neutron component of the mountain stations Sulphur, Climax, Zugspitze, Norikura, and Huancayo. A rather clear quasiperiodicity of the amplitude and phase of the solar-daily anisotropy with the period of solar rotation is shown from epicyclograms of the 27-day changes of the first harmonic of the solar-daily variation. Results of averaging the amplitudes of the first harmonic for each day, using two different methods, are shown. Curves of the 27-day changes are presented for each station. Averaged values of the latitude dependence of the amplitudes of the 27-day changes are given. Effects of solar activity, rigidity, and threshold rigidity are considered. (M.J.T.)

23979 WORLD-WIDE COSMIC-RAY INTENSITY INCREASES AND THEIR RELATION TO GEOMAGNETIC DISTURBANCES. Dorman, L. I.; Kebuladze, T. V.; Koridze, V. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1920-2(Oct. 1965). (In Russian).

The cosmic-ray intensity increases occurring during the magnetic storms of Aug. 17, 1957, Sept. 13, 1957, Feb. 11, 1958, and Aug. 17, 1958, were analyzed. The results of the analysis of the storm of Sept. 13, 1957, are examined. Cosmic-ray intensity increases were observed at the minimum of the Forbush effect and at the beginning of the main phase. The maximum intensity increase was observed at different times at different stations. No latitude or longitude dependence of the peaks of intensity growth was found. The variation of the amplitude of the intensity increases with the cutoff rigidity is discussed. (M.J.T.)

23980 PLANETARY DISTRIBUTION AND THE POSSIBLE INTERPRETATION OF SUDDEN RISES IN COSMIC-RAY INTENSITY ACCORDING TO THE DATA OF THE GLOBAL NETWORK OF STATIONS, NOT ASSOCIATED WITH VISIBLE FORMATIONS ON THE SUN. Alaniya, M. V.; Dorman, L. I.; Koridze, V. G.; Koiava, V. K.; Shatashvili, L. Kh. (Inst. of Geophysics, Academy of

Sciences, Georgian SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1923-6(Oct. 1965). (In Russian).

The planetary distribution, spectrum, and possible production mechanism of the sudden increases in cosmic-ray intensity are analyzed, using data of observations of the neutron component on mountain and ground-level stations during the IGY, choosing intensity increases ≥1%, and composing their frequency distribution as a function of time of recording at 2-hr intervals. Diagrams are given of the 24-hr frequency distributions of the sudden increases, the dependence of the time of maximum in the frequency distribution on the geomagnetic rigidity cutoff, and the averages of the superposition of epochs. The results are discussed with respect to planetary effects, conditions on the sun and in interplanetary space, daily variations, anisotropy, dependence on the altitude of observation, and cutoff rigidity. (M.J.T.)

23981 STUDIES OF COSMIC RAYS AT SUPERHIGH ENERGIES. Nikol'skii, S. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1927-34(Oct. 1965). (In Russian).

Studies of the energy spectrum and composition of the primary cosmic radiation with energies above 10^{15} ev are reviewed. Results of experimental and theoretical determinations of the energy spectra of EAS, cosmic photons, nuclear-active particles, and primary cosmic rays are illustrated. Some experiments which could be performed in the near future to increase knowledge of the nature of the primary cosmic radiation are listed. (M.J.T.)

23982 INTERACTION BETWEEN NUCLEONS AND COMPLEX NUCLEI AT HIGH ENERGIES. Guseva, V. V.; Lebedev, A. M.; Slavatinskii, S. A.; Sokolovskii, V. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1935-7(Oct. 1965). (In Russian).

Results of theoretical attempts to examine quantitatively the pion-nucleon cascade process in nucleon-nucleus interactions at energies of hundreds of Bev are discussed and compared with experimental findings obtained in the Pamir Mts. using a Wilson chamber and ionization calorimeter with Cu and LiH targets. The parameter of the angular-distribution anisotropy calculated as a function of the Lorentz factor for symmetric divergence of secondary particles agrees with experiment when computed on the basis of the cascade model of the interaction but disagrees when computed using the hydrodynamic model. In calculating the dependence of the anisotropy parameter on the multiplicity, the cascade model leads to qualitative agreement with experiment, but the hydrodynamic model disagrees with experimental results. The cascade model taking account only of the pion-nucleon interaction is in worse agreement with experiment than the model taking account of multiple collisions of nucleons and neglecting pion interactions within the nucleus. (M.J.T.)

23983 SOME DATA ON NEUTRON MEASUREMENTS IN THE ATMOSPHERE. Efimov, Yu. E.; Myakinin, E. V.; Romanov, A. M.; Shalak, N. I.; Yur'ev, V. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1942-5(Oct. 1965). (In Russian).

Slow and fast neutron fluxes in the atmosphere were measured at depths from about 7 to over 700 g/cm^2. The fast neutron fluxes were measured with a proportional counter surrounded by a moderator and with a stilbene scintillation counter. The slow neutron fluxes were measured with BF_3 counters and with In foils. At latitude 57°N and atmospheric depth from 78 to 94 g/cm^2 (the region of maximum intensity) the upward and downward fluxes of resonance neutrons were found to be the same and equal to $(3.63 \pm 0.83) \times 10^4$ neutron/cm^2 sec Mev, in good agreement with previous calculations. Data on fast neutron fluxes are given for 9 flights in 1962, 1963, and 1964 at latitudes 47° and 57°N. The atmospheric depth for maximum intensity ranged from 80 to 105 g/cm^2, and the absorption mean free path from 147 to 172 g/cm^2. The atmospheric depth for maximum intensity was found to increase with increasing neutron energy. The fast neutron flux at maximum was 2 neutron/cm^2 sec, considerably greater than that found in previous experiments. The maximum flux of slow neutrons occurred at an atmospheric depth of 90 g/cm^2, and the density of slow neutrons (energies below 10 kev) at this altitude was found to be 3.2×10^{-7} cm^{-3}. This density agrees within a factor of 2 with previous calculations. (M.J.T.)

23984 CALCULATIONS OF NEUTRON GENERATION BY μ MESONS AT VARIOUS DEPTHS UNDERGROUND. Zatsepin, G. T.; Ryazhskaya, O. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1946-8(Oct. 1965). (In Russian).

Calculations were carried out of the production of neutrons in the ground at depths from 0 to 10^4 mwe by the processes of direct electromagnetic interaction of muons with nuclei, interaction of photons from cascades induced by δ electrons, by pairs, and by bremsstrahlung, and capture of stopped muons by nuclei. Results are shown of the number of neutrons produced by a single muon in unit thickness of ground as a function of muon energy from 10 to 10^3 Bev and as a function of depth underground, for each production mechanism. Curves of the muon energy and intensity fluxes and the total intensity of generation of neutrons as functions of depth underground are correlated. (M.J.T.)

23985 HIGH-ENERGY NUCLEAR-ACTIVE PARTICLES AND EXTENSIVE ATMOSPHERIC SHOWERS AT ATMOSPHERIC LEVELS. Murzina, E. A.; Nikol'skii, S. I.; Yakovlev, V. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1949-52(Oct. 1965). (In Russian).

An analysis of the fluctuations of showers accompanying nuclear-active particles of set energy is made, and the results are compared with those from the Pamir experiment. Fluctuations in shower size are due to the production of particles of the set energy by primary nucleons of various energies, to variations in the shower development, and to the presence of part of the primary nucleons in the form of alpha particles and heavier nuclei. Experimental and calculated results are presented of the distribution of showers accompanying nuclear-active particles with energies of (1.3 to 2.6), (2.6 to 5.2), and (5 to 10) $\times 10^{12}$ ev. Possible causes of the discrepancies between the measured and calculated results are analyzed. (M.J.T.)

23986 ON THE IONIZING PARTICLES ACCOMPANYING APPROXIMATELY 170-Bev NUCLEONS AT 2 km ALTITUDE. Akopyan, G. S.; Bolotov, N. N.; Daion, M. I.; Devisher, M. I.; Knyazev, V. M.; Marikyan, G. A.; Matevosyan, K. A.; Shmeleva, A. P. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1953-5(Oct. 1965). (In Russian).

Ionizing particles accompanying high-energy cosmic nucleons at 2 km altitude were studied using a spark-chamber telescope in a 10-kOe field. The energy of the primary was measured with an ionization calorimeter. Primaries with energies from 100 to 300 Bev and spectral index of 1.8 ± 0.8 were observed. Secondaries with momenta between 1 and 30 Bev/c and spectral index of 1.2×0.5 were measured. The density of the accompanying particles was found to be about 20/m^2. The accompanying particles were determined to be largely muons. (M.J.T.)

23987 PRODUCTION OF SHOWERS BY 0.1- TO 20-Bev/c π MESONS AND PROTONS IN THIN PLATES. Khrimyan, A. V.; Avakyan, V. V.; Pleshko, M. P.; Vartanyan, T. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1956-61 (Oct. 1965). (In Russian).

The production of showers in matter by high-energy protons and pions was investigated in order to acquire data on the secondary background in rocket and satellite measurements of primary cosmic radiation. The measurements were performed at Aragats at 3200 m above sea level. The protons and pions were produced in lead by cosmic neutrons; their momenta were determined with the aid of a magnetic field, and their ionizing powers were measured with gas-filled proportional counters. The particles were classified according to their behavior in an interaction hodoscope consisting of layers of polystyrene, lead, and copper, with counter trays between them. Graphs of momentum vs ionizing power are given for the different particle types. It is concluded that 15% of the events recorded by a detector surrounded by 10

to 50 g/cm^2 of heavy metal are showers, that the probability of penetrating-shower production increases with increasing momentum of the initial particle, that at 0.1 to 0.7 Bev/c the frequency of shower production by pions is 2 to 4 times higher than that by protons, and that identification of primary cosmic electrons or photons by observing the showers they produce is difficult unless the secondary particles are identified. (ATD)

23988 ISOTOPIC ABUNDANCES AND ENERGY SPECTRA OF ^{3}He AND ^{4}He ABOVE 40 Mev PER NUCLEON FROM THE GALAXY. Fan, C. Y.; Gloeckler, G.; Hsieh, K. C.; Simpson, J. A. (Chicago Univ.). Phys. Rev. Lett., 16: 813-17(May 2, 1966).

Measurements are reported of the primary energy spectra of ^{3}He in the energy range ~40 to 110 Mev/nucleon, and of ^{4}He in the energy interval of 13 to 90 Mev/nucleon. Measurements were obtained by a dE/dx-vs-E cosmic ray telescope carried in the IMP-III satellite between 29 May to 20 September 1965. (B.G.D.)

23989 ON THE ORIGIN OF COSMIC RAYS. ter Haar, D. (Magdalen Coll., Oxford). pp 225-38 of Lectures in Theoretical Physics. Vol. VII C. Boulder, Colo., Univ. of Colorado Press, 1965.

The nature of the information on cosmic radiation is briefly discussed with emphasis on information obtained by the observation of radio emissions. The transport of cosmic rays in the interstellar medium is then considered, and a galactic theory of the origin of cosmic rays is outlined. Some quantitative aspects of a galactic theory of the origin of cosmic rays are discussed. (D.C.W.)

Direct Energy Conversion

Refer also to abstracts 23894 and 24193.

23990 (AD-625575) INTERACTION OF PLASMA FLOWS AND MAGNETIC FIELDS. Final Technical Report, November 15, 1963–June 1, 1965. Akhurst, Denys O. (Arkansas Univ., Fayetteville. Plasma Lab.). July 1965. Contract DA-23-072-AMC-168(Z). 79p. (UAPL-24). CFSTI $3.00 cy, $0.75 mn.

Some research on power generation through the interaction of plasmas and magnetic fields is summarized including both experimental and theoretical work in magnetohydrodynamics and superconductivity. (D.C.W.)

23991 (AD-625586) THE EFFECT OF SIMULATED FISSION PRODUCTS IN THE INTER-ELECTRODE SPACING OF A THERMIONIC DIODE. Annual Report No. 1, November 1, 1964–November 1, 1965. Davis, Monte V.; Backus, C. E.; Britt, E. J.; Turner, D. M. (Arizona Univ., Tucson. Engineering Experiment Station). Dec. 17, 1965. Contract Nonr-2173(13). 23p. CFSTI $1.00 cy, $0.50 mn.

The effects of fission products on the operation of an in-pile thermionic diode were investigated. Materials representing fission products were introduced into an operating diode, and the experimental results were compared with theoretical predictions. The effects of Ar, Kr, I, and Xe on the operation of a planar thermionic diode were studied as well as the effects of high temperatures on the insulating properties of ceramic materials. (D.C.W.)

23992 (AD-626593) INVESTIGATIONS USING SEGMENTED COLLECTOR THERMIONIC CONVERTERS. Yearly Technical Summary Report, January 1–December 15, 1965. Long, James D.; Psarouthakis, John (Martin Co., Baltimore, Md.). Jan. 15, 1966. Contract Nonr-3639(00). 78p. (MND-3247). CFSTI $3.00 cy, $0.75 mn.

A total of five different collectors were investigated as collector materials in thermionic converters each incorporating segmented collectors for simultaneous testing within the same environment. The metals tested were Nb, oxygenated Nb, plasma-sprayed Ru, Mo, and Re. One Ru collector surface was used in each diode to permit intercomparison of the two converters. Both converters used a single plasma-sprayed Ru emitter which was common to the three collectors. Ru, Nb, and oxygenated Nb were tested in the first converter. The collector work functions varied within about 0.1 ev from one substrate material to another, with minimum values as low as 1.1 ev. It is probable that the O in the oxygenated Nb either migrated to the other collector surfaces or evaporated and was subsequently absorbed by the other surfaces. The adsorbed O and Cs vapors probably formed CsO_2 and Cs-vapor layers on the substrate, thus bringing about the low work functions. Mo, Re, and Ru were tested in the second converter. This converter did not incorporate any purposely oxygenated surfaces. The work functions obtained from these metals with adsorbed Cs were higher than those under the pressure of O as expected. (TAB)

23993 (AD-627658) DIRECT ENERGY CONVERSION SYSTEMS. Final Technical Report, November 1, 1961–September 30, 1965. Eustis, Robert H. (Stanford Univ., Calif.). Oct. 29, 1965. Contract AF49(638)-1123. 25p. (AFOSR-65-2013). CFSTI $1.00 cy, $0.50 mn.

A brief summary is presented of the research conducted. Details of the work are reported in earlier reports. The scope of this program has included magnetogasdynamic, electrochemical, and thermoelectric studies. (TAB)

23994 (N-65-14601) INVESTIGATION OF AN MGD POWER GENERATION DUCT. Summary Report. Shair, Frederick H. (General Electric Co., Philadelphia, Pa. Missile and Space Vehicle Dept.). Jan. 15, 1965. Contract NAS3-4103. 95p. (NASA-CR-54124). CFSTI $3.00 cy, $0.75 mn.

An electron beam and externally applied electric fields were used to increase the plasma electric conductivity (above the neutral particle temperature Saha equilibrium value) in an MGD generator while maintaining a static gas temperature ~1500°K; the static pressure was ~1.5 atm. Preliminary experiments were conducted in pure argon, in argon seeded with cesium, and in argon seeded with mercury (metastable mixture). Electron densities were monitored at two positions (on either side of the magnetic field) by means of a 60-KMC microwave interferometer. The duct cross section was uniform at 1 cm × 3 cm. (STAR)

23995 (N-66-16138) MAGNETOGASDYNAMIC POWER GENERATION STUDY. Summary Report. Shair, F. H. (General Electric Co., Philadelphia, Pa. Missile and Space Vehicle Dept.). Jan. 20, 1966. Contract NAS3-6260. 60p. (NASA-CR-45575). CFSTI $3.00 cy, $0.50 mn.

Experiments were performed with an electron beam to increase the electric conductivity of a cesium-seeded argon plasma above the thermal equilibrium value in a subsonic duct at neutral particle temperatures up to 1500°K and pressures of the order of one atmosphere. Microwave interferometer diagnostic techniques indicated an electron density up to twenty times the Saha equilibrium value and a low electron density recombination rate which was supported, in qualitative trends at least, by theoretical analysis. Other subsonic experiments conducted with applied electric and magnetic fields and using cesium and cesium-mercury (Penning) seed mixture indicated the existence of low net induced voltages, while experiments with only applied electric fields showed the influence of several types of cathode material and a relatively insensitive dependence of performance on seeding rate. Calculations were also performed to determine the seed concentration required to obtain the optimum electric conductivity for a MHD generator operating in the non-equilibrium mode. The results indicated a reduction in the seed concentration as compared to the equilibrium situation. (STAR)

23996 (NYO-3642-1) THE DEVELOPMENT OF AN ADSORPTION CESIUM RESERVOIR. First Quarterly Technical Report. (Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.). Mar. 1966. Contract AT(30-1)-3642. 22p. Dep. mn. CFSTI $0.50 cy, $0.50 mn.

An investigation was made to develop an adsorption-type

cesium reservoir for a long life thermionic converter. Investigations were made on: reservoir materials, reservoir geometries and operating temperatures, cesium coverage rates and the total quantity of cesium stored on adsorption surfaces, operation of the improved converter when utilizing single and double reservoirs, and the performance of converters incorporating adsorption reservoirs with that of converters using liquid cesium reservoirs. (M.O.W.)

23997 (TID–22735, pp 153-7) ENERGY CONVERSION RESEARCH. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Research concerned with development of efficient stagnation pressure generators and cycles for use in liquid-metal magnetohydrodynamic (MHD) power systems is described. Information is included on MHD induction generators, alkali-metal MHD generators, and Hall instabilities in MHD generators. (J.R.D.)

23998 A REVIEW OF WORK IN JAPAN ON THE DIRECT CONVERSION OF NUCLEAR ENERGY TO ELECTRICITY. I. Nippon Genshiryoku Gakkaishi, 8: 28-35 (1966). (In Japanese).

A summary is given of the activities of the "Special Committee on Direct Conversion of Nuclear Energy to Electricity" in the two years from its establishment in October 1963 to its termination in September 1965. The review covers the present status of the studies undertaken and the technical problems involved are reviewed on magnetohydrodynamic power generation. The subjects reviewed include nonequilibrium ionization, electronic phenomena in the boundaries of electrodes, thermodynamic and fluid mechanical problems, liquid metal MHD power generation, high temperature materials, and technical problems relating to the development of MHD power generation plants. Problems concerning other conversion methods and the associated high temperature nuclear reactors will be reviewed in the following issue. (auth)

23999 FUEL CELL. Kawata, Shigeru (to Nippon Kokan K.K.). Japanese Patent 1964-12843. June 23, 1965. Filed July 28, 1962.

A fuel cell designed for industrial power generation contains a radioisotope dissolved in the electrolyte or attached to the matrix. The radiation from the radioisotope enhances the action of a catalyst used on the electrodes. In addition to the resulting simplifications in construction, the electromotive force is raised, and the electric current density is considerably increased. Any radioisotope can be used if it does not react chemically with the electrolyte or the matrix. (TCO)

24000 LOW TEMPERATURE THERMIONIC ENERGY CONVERTER. Hernqvist, Karl G. (to Radio Corporation of America). U. S. Patent 3,239,745. Mar. 8, 1966. Filed Aug. 25, 1960.

A low temperature thermionic energy converter consists of an envelope containing the thermionic cathode, a collector electrode spaced from the cathode, an ionizable gas, and a third electrode located adjacent to and electrically insulated from the cathode. The third electrode is adapted to produce positive ions when heated independently of electron impact. The cathode is maintained at electron emitting temperature, and the third electrode is maintained at a positive dc potential with respect to the cathode below the ionization potential of the gas. The gas is momentarily ionized to produce the initial plasma in the envelope while the electrode is maintained at ion-producing temperature to maintain a continuous plasma after the initial plasma production. (B.L.M.)

24001 ANISOTROPIC WALL STRUCTURE, PARTICULARLY FOR AN MHD GENERATOR. Novack, Martin E.; Russell, Robert H. (to Avco Corp.). U. S. Patent 3,242,354. Mar. 22, 1966. Filed Apr. 8, 1963.

An anisotropic wall structure, particularly for a MHD generator, comprises a plate of electric insulation on which a number of spaced, thermally conductive members are supported. Opposing ends of the thermally conductive members define in part a surface remote from the plate of electric insulation. The thermally conductive members are axially aligned in one direction and include axially aligned passages. The wall structure also includes linking means for forming a continuous conduit means in conjunction with the axially aligned passages. The linking means comprises a sleeve of electrically nonconductive material inserted adjacent to the axially aligned passages. Sealing means between the conductive members and the linking means prevent the leakage of fluid from the conduit means. (B.L.M.)

Elementary Particles and Radiations

See also Field Theory, Scattering Theory, and Symmetries

Refer also to abstracts 22976, 23924, 23931, 24254, 24260, and 24362.

24002 (AD–625362) MODAL ANALYSIS AND SYNTHESIS OF ELECTROMAGNETIC FIELDS. Felsen, L. B.; Marcuvitz, N. (Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.). Aug. 5, 1965. Contract AF19(628)-4324. 70p. (AFCRL–65–668). CFSTI $3.00 cy, $0.75 mn.

After a general discussion of nonharmonic electromagnetic processes from the viewpoint of temporal Fourier (or Laplace) analysis and synthesis, a class of problems is considered for which the transient solution may be recovered in simple form. Included in this category are pulsed-point, line, and plane-wave sources in free space and in the presence of a dielectric half-space, a perfectly absorbing or perfectly conducting wedge or half plane, and a unidirectionally conducting infinite and semi-infinite screen. Explicit expressions for the transient response are interpreted in physical terms. Attention is then given to a second class of problems in which an electric charge moves uniformly along a straight trajectory in various environments. The associated radiation is now of the Cherenkov type, and formulas for the fields as well as the radiated power are given. (TAB)

24003 (CALT-68-26) A MULTI-CHANNEL DOUBLE BOOTSTRAP FOR THE ρ AND K* MESONS. Gerbracht, Robert (California Inst. of Tech., Pasadena). Jan. 1965. Contract AT(11-1)-68. 70p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Features of the bootstrap mechanism were investigated in a complex case involving many channels. The ρ meson is generated in the $\pi\pi$, $\pi\omega$, and $K\bar{K}$ channels, while the K* meson is simultaneously formed in the πK and ηK channels. A single self-consistent solution to the resulting seven coupled equations exists, and the calculation produces predictions for the ρ and K* masses and for the five coupling constants $\gamma_{\rho\pi\pi}$ (or $\gamma_{\rho\pi\omega}$), $\gamma_{\rho KK}$, $\gamma_{\omega KK}$, $\gamma_{\eta KK^*}$, $\gamma_{\omega KK^*}$. Typical results are M_ρ = 750 Mev, M_{K^*} = 900 Mev, while the prediction for the only experimentally known coupling constant ($\gamma_{\rho\pi\pi}$ or $\gamma_{\rho\pi\omega}$) matches the experimental value. The other coupling constants approximate the values predicted by SU(3) symmetry with the exception of $\gamma_{\eta KK^*}$ and, to a lesser extent, $\gamma_{\omega KK}$. The effects of the ϕ meson, including ϕ-ω mixing, the $\pi\phi$ channel, and ϕ exchange forces, are discussed and estimated. The basic calculational tool is the matrix ND^{-1} technique with the first determinantal approximation—the influence of this approximation is evaluated through a comparison of the results using the approximation with those from solving the exact equations for a suitable test problem. The results apparently justify the use of the approximation. The good results obtained from the calculation demonstrate that the bootstrap idea continues to work even for rather complicated cases, and continues to give sensible answers. (auth)

24004 (CERN–65–24(Vol.2)) PROCEEDINGS OF THE 1965 EASTER SCHOOL FOR PHYSICISTS USING THE CERN

PROTON SYNCHROTRON AND SYNCHRO-CYCLOTRON, BAD KREUZNACH, APRIL 1–15, 1965. (European Organization for Nuclear Research, Geneva (Switzerland)). Sept. 21, 1965. 111p. Dep. mn.

Separate abstracts were prepared for each of the five papers included. (G.O.Y.)

For abstracts of individual papers see: 23876 and 24005–24008.

24005 (CERN–65-24(Vol.2), pp 1-17) ELECTROMAGNETIC FORM FACTORS OF NUCLEONS. Beckmann, P. E. (Mainz Univ. (West Germany). Institut fuer Theoretische Physik).

The interaction of electrons and nucleons is studied using primarily the one-photon-exchange approximation. The analysis of scattering data in terms of form factors is emphasized. Some tests of the validity of the one-photon approximation are outlined. (D.C.W.)

24006 (CERN–65-24(Vol.2), pp 19-53) PHOTOPRODUCTION. Rollnik, H. (Bonn Univ. (West Germany). Physikalisches Institut).

The general principles of the theoretical description of photoproduction are outlined. The differences between photoproduction and hadronic two-body processes are emphasized. The s-channel resonances are treated in detail. 70 references. (D.C.W.)

24007 (CERN–65-24(Vol.2), pp 55-66) SPECIAL MODELS AND PREDICTIONS FOR PION PHOTOPRODUCTION (LOW ENERGIES). Hoehler, G. (Technische Hochschule, Karlsruhe (West Germany). Institut fuer Theoretische Kernphysik).

Some studies of photoproduction that deal with the isobar approximation and the phenomenological analysis are briefly reviewed. (D.C.W.)

24008 (CERN–65-24(Vol.2), pp 67-87) THE ELECTROMAGNETIC STRUCTURE OF THE NUCLEON. Meyer-Berkhout, U. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)).

The analysis of electron-scattering data for information on the nucleon form factors is discussed. Only form factors in the region of space-like four-momentum transfers are considered. The validity of the one-photon-exchange approximation for e-N scattering is discussed, and the experimental information on the nucleon form factors is summarized. (D.C.W.)

24009 (CERN–65-24(Vol.3)) PROCEEDINGS OF THE 1965 EASTER SCHOOL FOR PHYSICISTS USING THE CERN PROTON SYNCHROTRON AND SYNCHRO-CYCLOTRON, BAD KREUZNACH, APRIL 1–15, 1965. (European Organization for Nuclear Research, Geneva (Switzerland)). Feb. 14, 1966. 104p. Dep. mn.

Separate abstracts were prepared for 3 of the 4 included papers. An abstract of the remaining paper appeared previously in NSA as 19: 37563. (M.O.W.)

For abstracts of individual papers see: 24010, 24011, and 24092.

24010 (CERN–65-24(Vol.3), pp 65-86) NEUTRINO PHYSICS. Perkins, D. H. (Oxford Univ. (England)).

Separate discussions are included on: the basic properties of neutrinos; neutrino interactions (physics problems relating to lepton currents and weak baryon currents); technical innovations necessary to investigate these problems at accelerators; and related topics (reactor and extra-terrestrial experiments). (M.O.W.)

24011 (CERN–65-24(Vol.3), pp 87-100) CP INVARIANCE. Winter, K. (European Organization for Nuclear Research, Geneva (Switzerland)).

In an earlier paper, the observation of the decay of the long-lived component of a K^0 beam into 2 charged pions was reported. The possible interpretations of this result are discussed. Previous evidence is reviewed that CP may be an exact symmetry principle. (M.O.W.)

24012 (COO–427-47) N/D CALCULATION OF THE 1688 Mev PION NUCLEON RESONANCE. Smith, F. C.; Johnson, W. R. (Notre Dame Univ., Ind.). [1965]. Contract AT(11-1)-427. 7p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The spin-parity assignment of the 1688-Mev π-N resonance was studied using the N/D method to evaluate the $D_{\frac{3}{2}}$ and $F_{\frac{5}{2}}$ partial-wave amplitudes. The results indicate that the 1688-Mev resonance has a spin-parity assignment of $D_{\frac{3}{2}}$. (D.C.W.)

24013 (DESY–66/2) PHOTOERZEUGUNG VON π MESONEN. II. TEIL. (Photoproduction of π Mesons. Part II). Stichel, P. (Deutsche Elektronen-Synchrotron, Hamburg (West Germany)). Feb. 1964. 106p. Dep. mn.

Photoproduction of π mesons in the Bev-region is discussed. The foundation of the peripheral model and a detailed discussion of its application to photoproduction processes are included. (M.O.W.)

24014 (DESY-66/4) THE PIONIC FORM FACTOR OF THE FIRST πN RESONANCE. Gutbrod, F. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Feb. 1966. 34p. Dep. mn.

Off-shell π-N scattering in the $\frac{3}{2}$, $\frac{3}{2}$-state is treated by the Omnès-Muskhelishvili method. The left-hand cut is represented by nucleon exchange and by approximate double spectral functions coming from iterations of nucleon exchange; on the right-hand cut some inelasticity is assumed. The off-shell amplitude is roughly determined by the behavior of the Born term at resonance energy, but is not insensitive to the absorption at high energies. If the form factor is approximated by a single pole in momentum transfer, the relevant mass is 1.5 nucleon masses. (auth)

24015 (MIT–2098-223) PHOTOPRODUCTION OF SINGLE π^+ AND K^+ MESONS FROM HYDROGEN AT INCIDENT ENERGIES NEAR 4.0 Bev [Thesis]. Technical Report No. 81. Elings, Virgil Bruce (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Mar. 1966. Contract AT(30-1)-2098. 79p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The differential cross sections for the following reactions were measured: $\gamma + p \rightarrow \pi^+ + n$, $\gamma + p \rightarrow K^+ + \Lambda^0$, and $\gamma + p \rightarrow K^+ + \Sigma^0$. The cross sections were measured at incident photon energies from 3.4 to 4.0 Bev and at meson center-of-mass angles from about 25 to 45 degrees. The momenta, velocities, and angles of the mesons were measured using a magnetic spectrometer and the gamma ray energy was determined by doing bremsstrahlung subtractions. The cross sections, when compared at the same total center-of-mass energy and center-of-mass angle, agree very well with the inequality given by the symmetry theory of SU(3). (auth)

24016 (NP–15943) DIFFUSION DES ELECTRONS DE HAUTE ENERGIE SUR LE PROTON [Theses]. (Scattering of High-Energy Electrons on Protons [Thesis]). Dudelzak, Boris (Paris Univ., Orsay (France). Faculte des Sciences). 1965. 122p. Dep. mn.

A theoretical and experimental study is made of the scattering of high energy electrons on protons. The concepts and relations defining the experimental conditions are used to interpret the experimental results. Kinematics of electron-proton elastic diffusion are first considered. The theoretical cross section of elastic scattering is then discussed and the theories used to interpret the experimental results are reviewed. The experimental devices, methods, and techniques are described in detail. The experimental results obtained are then reported. A theoretical and phenomenological interpretation is given of the results. (J.S.R.)

24017 (UCRL–11985) EXCHANGE PROCESSES AND $^1S_0$ n-p SCATTERING LENGTH. Shield, E.; Slobodrian, R. J. (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 10, 1965. Contract W-7405-eng-48. 7p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Neutron-proton scattering is described by a wave function with a short range potential and a wave function with-

out any defined symmetry which satisfies Schroedinger's equation. The individuality of the proton and neutron is questioned and a theory is derived for the scattering length of the $^1S_0$ interaction. (M.O.W.)

24018 (AERE-Trans-1047) THE PLANNING OF n-p SCATTERING EXPERIMENTS FOR DETERMINING THE MOST PROBABLE SET OF PHASE SHIFTS. Lehar, F.; Fedorov, V. V. Translated by D. L. Allan (Atomic Energy Research Establishment, Harwell (England)), from JINR Preprint R-2332. 1965. 13p. Dep. BIS $0.50. HMSO 2s. 6d.

An optimal experiment is planned to distinguish between three sets of phase shifts in n-p scattering at 630 Mev. (auth)

24019 EFFECT OF ORDERING ON THE ANGULAR DISTRIBUTION OF ANNIHILATION QUANTA FROM p-AZOXYANISOL. Wesolowski, J.; Szuszkiewicz, M.; Szuszkiewicz, S. (Wroclaw Univ.). Acta Phys. Pol., 29: 97-102(Feb. 1966).

The angular distribution of photons from two-quantum annihilation of an electron-positron pair in p-azoxyanisole is measured. The compound is a "liquid crystal" wherein distinct phases with a high degree of ordering arise in certain temperature intervals. p-Azoxyanisol presents one such phase, known as nematic. The angular distribution in the nematic phase was studied at two different temperatures, and in the normal-liquid phase at one. The results point to an angular distribution of annihilation quanta dependent on the degree of ordering of the molecules in the various phases. (auth)

24020 INVESTIGATION OF NEUTRON-PROTON SCATTERING AT 14.1 Mev WITH HIGH-PRESSURE DIFFUSION CHAMBERS. Greiner, E.; Karge, H. (Friedrich-Schiller-Univ., Jena, Ger.). Ann. Phys. (7), 16: 354-9 (1965). (In German).

The angular distribution of neutron-proton scattering at 14.1 Mev was determined in the region $180° \geq \theta \geq 80°$ with a high-pressure diffusion chamber. The approximation of the midpoint by a $\cos^2\theta$-distribution yielded an anisotropy factor $\sigma(180°)/\sigma(90°)$ of 1.074 ± 0.04. The results are compared with previous experimental and theoretically obtained distributions. In particular, the angular distribution measurements with a diffusion chamber are discussed. (tr-auth)

24021 STUDY OF THE ELECTRON-DEUTERON SCATTERING BY OBSERVATION OF THE RECOIL DEUTERON. Bensakas, David (Ecole Normale Superieure, Orsay, France). Ann. Phys. (Paris) (13), 10: 715-41(Nov.-Dec. 1965). (In French).

An experimental method that makes possible the direct measurement of the electron-deuteron magnetic scattering by observation of the recoil deuteron at 0° is described. With this method the magnetic form factor of the deuteron could be measured for the quadritransfer values q^2 = 3, 4, and 5 fermi^{-2}. Two series of measurements at a recoil angle of 45° on the deuteron and on the proton made it possible to deduce the electric form factors of these nuclei and, with the aid of a nonrelativistic theory, to deduce the form factor of the deuteron for the transfer values of q^2 = 3, 4, 5, and 6 fermi^{-2}. (tr-auth)

24022 β DECAY OF NEGATIVE MUONS IN A DIVERGENCELESS LEPTON THEORY. Hofer, Hans (Univ., Bern). Helv. Phys. Acta, 39: 49-57(1966). (In German).

The beta decay of muons in a second-order perturbation calculation is discussed in a divergence-free theory of leptons proposed by Sudarshan. The main principle of the theory consists of four auxiliary fields with indefinite metric. The auxiliary mass associated with these fields regulates the fermion propagator, so that ultraviolet divergences no longer occur. It is shown that the matrix element for the muon decay satisfies the unitarity condition, if the auxiliary masses satisfy certain conditions. The electron spectrum, the electron-direction spectrum, and the muon lifetime are then approximately calculated. The exact determination of the four auxiliary masses is not possible on the basis of present experimental information. An upper bound can be given however, which lies at approximately 25 muon masses. (tr-auth)

24023 ANOMALOUS TRANSITION EFFECT FOR NUCLEAR DISINTEGRATIONS INDUCED BY HIGH ENERGY PARTICLES. Varsimashvili, T. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1669(Sept. 1965). (In Russian).

Nuclear-active particles were produced in a 10-g/cm^2 polyethylene target by a 10-Bev synchrophasotron proton beam. The anomalous transition effect for nuclear disintegrations in lead, reported previously for cosmic-ray particles, was observed by counting the stars produced in nuclear emulsions stacked between lead slabs. The relative number of stars produced at depth x in the lead was given by $0.98 + 0.48(x/L) \exp(-x/L)$ with L = 5 mm. This anomalous transition effect was not present in control runs without the polyethylene target. (M.J.T.)

24024 ANALYSIS OF ENERGY CHARACTERISTICS OF HIGH-ENERGY NUCLEAR REACTIONS IN PHOTOEMULSIONS. Zhdanov, G. B.; Cheremiskina, A. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1938-41(Oct. 1965). (In Russian).

Methods for determining the energy of nuclear interactions in emulsions in the presence of a fixed energy threshold are evaluated, using data on about 50 primary and 135 secondary interactions. The method of Castagnoli, $E = 2\gamma_c^2 M$, where γ_c is the cms Lorentz factor and M is the nucleon mass, is shown to be the least accurate of all existing methods. Three other methods are considered: $E = E_\gamma/K^0_{lab}$, where E_γ is the energy of the soft component of a shower and K^0_{lab} is the corresponding coefficient of inelasticity in the lab system; $E = \bar{P}_\perp \epsilon\, \theta_i^{-1}/K^\pm_{lab}$, where $\bar{P}_\perp$ is the average transverse momentum, θ_i is the angle of emission of the secondary particles, and $K^\pm_{lab}$ is the corresponding coefficient of inelasticity; $E = \bar{P}_\perp/\theta_0$, where θ_0 is the angle of flight of the original particle relative to the direction of the particle inducing the preceding interaction. The energy spectra of primary and secondary interactions, calculated using these formulas, are shown and compared with experimental values. (M.J.T.)

24025 ANALYSIS OF ELASTIC d-d SCATTERING IN TERMS OF N-N INTERACTIONS. Queen, N. M. (Univ. of Birmingham, Eng.). Nucl. Phys., 80: 593-607(1966).

A partial summation of multiple scattering corrections to the impulse approximation for collision processes involving composite particles is carried out and is shown to give unitarity corrections to the single scattering approximation. Numerical calculations of elastic d-d scattering at 60 and 650 Mev are made, using no arbitrary parameters except those describing the two-body interaction, i.e., the N-N scattering amplitude and the deuteron wave function. Reasonable agreement with experimental data is obtained at small momentum transfers. The d-d scattering at large momentum transfers is found to be extremely sensitive to the deuteron structure; e.g., inclusion of a 7% D-state deuteron probability leads to an increase in the 650 Mev d-d differential cross section at 90° by a factor of 100, bringing the theoretical results into much better agreement with the data than those obtained assuming a pure S-state deuteron. (auth)

24026 SUM RULES FOR THE COUPLING CONSTANTS OF THREE BOSON OCTETS IN BROKEN SU_3. Gupta, V. (California Inst. of Tech., Pasadena). Nuovo Cimento (10), 42: 737-42(Apr. 21, 1966). (CALT-68-49).

Sum rules for the coupling constants of three bosons octets are given. They are applied to K** (1430) and A_2 (1320) resonances. It is concluded that they belong to a $J^P = 2^+$ octet rather than a 27-plet. (auth)

24027 REMARKS ON THE STRONG ASYMPTOTIC DECREASE OF FORM FACTORS. Balachandran, A. P. (Syracuse Univ., N. Y.). Nuovo Cimento (10), 42: 804-13 (Apr. 21, 1966). (NYO-3399-19).

Wu and Yang have recently suggested on the basis of statistical considerations that the nucleon electromagnetic form factor F(t) (which may be either electric or magnetic) should decrease like $\exp[-c|t|^{1/4}]$, $c > 0$ when the square of

the invariant momentum transfer t tends to infinity. They have also shown that this behavior is consistent with the experimental data on F(t) for large spacelike momentum transfers. It is proved that if F(t) decreases faster than any inverse power of t when $t \to -\infty$, and ImF(t) = O $(\exp[-c|t|^{1/2}])$, $c > 0$ when $t \to +\infty$, then F(t) is uniquely determined by the subtraction function G(t) associated with its dispersion relation and that this function must be an entire function of nonzero order. It is also shown that F(t) must increase faster than any power of t when $t \to \infty$ along some real or complex direction. The spectral function for F(t) is explicitly exhibited as the Fourier transform of an analytic function, which is defined by a power series in a certain domain of its regularity. The power series involves only quantities that are determined by G(t). Unitarity is not used in the proof so that the unitary structure of F(t) and hence the mass spectrum in the t-channel must be consequences of the properties of G(t) and of the assumed asymptotic behavior of F(t). (auth)

24028 π^-p CHARGE-EXCHANGE SCATTERING AT 10 Gev/c. Backenstoss, G.; Hyams, B.; Maenner, W.; Reale, A.; Stierlin, U. (CERN, Geneva). Nuovo Cimento (10), 42: 814-21(Apr. 21, 1966).

π^-p charge-exchange scattering was measured with 10 Bev/c incident pions. A spark-chamber pair spectrometer was used to determine the kinematics. The angular distribution was measured in the range of four-momenta $0 < t < 0.3$ $(\text{Bev/c})^2$. (auth)

24029 IS ABSORPTION NECESSARY IN HIGH-ENERGY INELASTIC PROCESSES? Selleri, F. (Univ., Bologna). Nuovo Cimento (10), 42: 835-43(Apr. 21, 1966).

Two arguments are presented against the presence of important absorptive effects in high-energy physics. The first comes from the phenomenological analysis of single-pion production in pp collisions and the second from the application of the random phase approximation to the unitarity condition for an inelastic process. (auth)

24030 PION PRODUCTION IN PROTON-PROTON COLLISIONS AT 610 Mev. Busza, W. (London Univ.); Davis, D. G.; Duff, B. G.; (and others). Nuovo Cimento (10), 42: 871-7(Apr. 21, 1966).

The process $pp \to pp\pi^0$ was studied at 610 Mev for low four-momentum transfer collisions. The angular distributions of the outgoing protons are compared with the one-pion exchange peripheral model. It is found that the form factor derived from pion production at higher energies gives good agreement between the observed and theoretical angular distributions. (auth)

24031 FOURIER-BESSEL REPRESENTATION FOR HELICITY AMPLITUDES. Luming, M.; Predazzi, E. (Univ. of Chicago). Nuovo Cimento (10), 42: 878-93 (Apr. 21, 1966). (COO-264-290; EFINS-65-99).

It is shown that two types of Fourier-Bessel representation for the helicity amplitude, which are valid for arbitrary physical energies and scattering angles, can be derived from the Jacob-Wick expansion. Provided certain conditions are satisfied, the spectral functions are expressed as Neumann series over the partial-wave amplitudes; and conversely, the latter are expressed as integrals over the former. High-energy unitarity conditions on the spectral functions are derived for the case of πN scattering; and an illustration of the use of such unitarity conditions is briefly discussed. (auth)

24032 POLARIZATION IN HIGH-ENERGY πp ELASTIC AND CHARGE-EXCHANGE SCATTERING. Bialas, A.; Svensson, B.E.Y. (CERN, Geneva). Nuovo Cimento (10), 42: 908-29(Apr. 21, 1966).

The phenomenological discussion of various polarization measurements in high-energy πp elastic and charge-exchange scattering is given in terms of the helicity formalism. Both the high-energy limit and the high-energy behavior of the polarization are discussed under various assumptions suggested by the experimental data and/or theoretical models. The case when the nonspin-flip amplitude dominates the high-energy elastic scattering is considered in some detail. (auth)

24033 ELASTIC SCATTERING, PION PRODUCTION, AND ANNIHILATION INTO PIONS IN ANTIPROTON-PROTON INTERACTIONS AT 5.7 Gev/c. Boeckmann, K. (Univ., Bonn. KFA Juelich, Bonn); Nellen, B.; Paul, E.; (and others). Nuovo Cimento (10), 42: 954-96(Apr. 21, 1966).

An extensive investigation of antiproton-proton interactions at 5.7 Bev/c without strange-particle production was carried out using a hydrogen bubble chamber. Cross sections for different channels are given and discussed. The reliability of the analysis was checked using artificially generated events. The cross sections for elastic scattering, for all processes involving annihilation, and for all other inelastic processes are respectively $\sigma_{el} = (16.3 \pm 0.6)$ mb, $\sigma_{annihil} = (22.5 \pm 2.0)$ mb, $\sigma_{inel} = (24.8 \pm 2.0)$ mb. The N^*_{1238} is present both in the single and multiple pion production channels. For the reaction $p\bar{p} \to N^*\bar{N}^*$ a cross section of (1.05 ± 0.21) mb was obtained. Cross sections N^*_{1238} production in other channels are also given. Some indication of the presence of $I = 1/2$ isobars was found in the nucleon-pion and the nucleon-two-pion systems. The inelastic nonannihilation reactions were found to be strongly peripheral. The one-pion exchange model including either a form factor or corrections for absorption was applied to the reaction $p\bar{p} \to N^*\bar{N}^*$. Neither version of the model could correctly account for all features of the reaction. The average number of pions in the annihilation was found to be 7.3 ± 0.6. The presence of an asymmetry in the angular distribution of the charged pions was confirmed at this energy; it is due mostly to high-energy pions. The production of ρ and ω mesons was observed in various annihilation channels. Rates of up to 80% for ρ production and up to 15% for ω production were obtained by fitting phase-space and Breit-Wigner curves to the effective-mass distributions of different channels. (auth)

24034 CHARGE-DEPENDENT CORRECTIONS IN PHOTOPRODUCTION OF POSITIVE PIONS. Srinivasan, S. K. (Indian Inst. of Tech., Madras); Achuthan, P.; Ramabhadran, V. Nuovo Cimento (10), 42: 997-9(Apr. 21, 1966).

It is demonstrated, by taking into account charge-dependent corrections to pion-nucleon scattering, that the polarization of the recoil nucleon is sensitive to small changes in the amplitude. The results are of interest, particularly in view of certain tests proposed for the violation of time reversal invariance in photoproduction of pions. (L.B.S.)

24035 NOTE ON THE RATIO BETWEEN THE ELECTRIC AND MAGNETIC FORM FACTORS OF THE PROTON. Costa, G.; Tonin, M. (Univ., Padua. Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (10), 42: 1015-18(Apr. 21, 1966).

It is pointed out that the hypothesis of the meson-pole dominance used along with the U_{6w} symmetry for predicting the electromagnetic form factors of nucleons leads to a different prediction for μ_p, if the pole approximation is made in the Dirac and Pauli form factors, and moreover, the pole-dominance model seems to be inconsistent with the symmetry requirement $G_E(q^2 = 4M^2) = G_M(q^2 = 4M^2) = 0$, where G_E and G_M are the Sachs form factors. A different derivation is given of the ratio of the electric and magnetic form factors of the proton, which seems not to be affected by these difficulties. The derivation is based on the U_{6w} symmetry and on a relation of the Goldberger-Treiman type. (L.B.S.)

24036 ANALYSIS OF SUM RULES FOLLOWING FROM LOCAL COMMUTATION RELATIONS OF CURRENTS. Buccella, F. (Univ., Florence); Veneziano, G.; Gatto, R. Nuovo Cimento (10), 42: 1019-28(Apr. 21, 1966).

A survey of the electroproduction kinematics is presented and Adler's sum rules for neutrino processes are written in a form suitable for electroproduction. A theoretical analysis is made of the sum rules, beginning with an examination of the N* contribution. An approximate connection is derived between the Adler-Weisberger expression for g_A/g_V and the derivative of the sum rule

obtained from the local commutation relation. The extension to strange currents is considered and the main results are derived. Some further speculations on the higher q^2 values, and on the sum rule following from commutation of space components are summarized. (L.B.S.)

24037 DO WEAK INTERACTIONS INVOLVE NON-OCTET CURRENTS? d'Espagnat, B.; Gaillard, M. K. (Univ. Paris, Orsay, France). Nuovo Cimento (10), 42: 1035-40(Apr. 21, 1966).

The assumption of exact octet transformation properties of weak currents in SU_3 is examined. It is pointed out that the assumption excludes the presence of $\Delta S = -\Delta Q$ and $|\Delta S| = 2$ currents, which would induce $|\Delta S| = 2$ nonleptonic transitions in a simple current-current picture. The problem of whether or not nonoctet currents participate in weak interactions is considered, and some consequences are pointed out of the two assumptions that: currents in "10", "10", or "27" are coupled to leptons along with the usual current in "8"; and a "weak hypercharge" Y is conserved in these couplings. (L.B.S.)

24038 HYPERON-NUCLEON SCATTERING BY THE N/D METHOD. Dass, Guru Vachan (Delhi Univ.). Nuovo Cimento (10), 42A: 453-77(Apr. 1, 1966).

Within the one-boson exchange model, an N/D calculation of elastic lambda-nucleon scattering (below the Σ-production threshold) and of Σ-nucleon scattering in the $T = 3/2$ state was done in the Zachariasen-Zemach approximation. The scalar, the pseudoscalar and the vector meson exchanges in the crossed channels have been assumed to give rise to the forces responsible for the interaction. The antisymmetric spin-orbit term in the hyperon-nucleon scattering matrix was retained and the spin singlet-triplet mixing (which is a consequence of this term) was also investigated. Keeping only the phase shifts and mixing parameters with $L \leq 2$ and $J \leq 2$, the polarizations of the scattered hyperon and the recoiling nucleon, and the differential and the total cross sections were evaluated. Wherever possible, comparison with experiments is made. The coupling constants of the meson exchange diagrams were fixed up by invoking SU_3 symmetry and in some cases, empirically, by requiring the model to conform to some other requirements. (auth)

24039 TEST OF TIME-REVERSAL INVARIANCE IN π^+ PHOTOPRODUCTION. Dietz, K. (CERN, Geneva); von Gehlen, G. Nuovo Cimento (10), 42A: 537-48(Apr. 1, 1966).

It is proposed to measure polarizations of the recoil neutron in π^+ photoproduction in order to detect a possible T violation in the electromagnetic interaction of hadrons. Several possibilities of introducing T-violating terms in the photoproduction current are discussed. (auth)

24040 ELECTROMAGNETIC CORRECTIONS TO THE LOW-ENERGY πN SCATTERING IN $J = 3/2$ $T = 3/2$ STATE. Bose, S. (Delhi Univ.). Nuovo Cimento (10), 42A: 589-92(Apr. 1, 1966).

The S-matrix method of Dashen and Frautschi to calculate the effect of perturbations on strong interaction, is applied to calculate the electromagnetic difference in scattering length between $T_3 = 3/2$ and $T_3 = -3/2$ for p-wave πN scattering in $T = 3/2$, $J = 3/2$ state. Also the e.m. difference in scattering length between $T_3 = 1/2$ and $T_3 = -1/2$ in $T = 1/2$, $J = 1/2$, p-wave πN scattering is calculated. (auth)

24041 ANALYSIS OF STRANGE-PARTICLE PRODUCTION IN π^-p COLLISIONS AT 1.59 Gev/c. Goussu, O. (CEN, Saclay, France); Sene, M.; Ghidini, B.; Mongelli, S.; Romano, A.; Waloschek, P.; Alles-Borelli, V. Nuovo Cimento (10), 42A: 606-18(Apr. 1, 1966).

The production of strange particles in π^-p interactions at 1.59 Bev/c was studied in a hydrogen bubble chamber experiment. Production and decay angular distributions are presented for the Λ^0K^0 and Σ^-K^+ final states. The $Y_1^*(1385)$ is observed in the $Y K\pi$ final states. The results are compared with experiments at other incident pion energies. (auth)

24042 EVIDENCE FOR A STRONG, POSSIBLY RESONANT, SCALAR $\rho\rho$ INTERACTION. Bettini, A. (Univ.. Padua. Istituto Nazionale di Fisica Nucleare, Padua); Cresti, M.; Limentani, S. (and others). Nuovo Cimento (10), 42A: 695-702(Apr. 1, 1966).

In the study of the annihilation $\bar{p}n \rightarrow \pi^+\pi^+\pi^-\pi^-\pi^-$ at rest in deuterium, a deviation of the $\pi^+\pi^+\pi^-\pi^-$ effective-mass distribution with respect to the prediction of phase space was found. It is shown that this deviation could be satisfactorily explained in terms of a $\rho\rho$ resonance with m = 1.410, $\Gamma = 0.090$ Bev/c^2, $J^{PG} = 0^{++}$ and I = 0 or 2. (auth)

24043 MESON-BARYON AND BARYON-BARYON SCATTERING IN BROKEN SU_3 IN AN ω-ϕ MIXING MODEL. Gupta, S.; Agarwal, S. Chandra (National Physical Lab., New Delhi). Nuovo Cimento (10), 42A: 703-6(Apr. 1, 1966).

An attempt is made to obtain the meson-baryon and baryon-baryon scattering amplitude sum rules in broken SU_3 by using the ω-ϕ mixing with the framework of S-matrix theory. (L.B.S.)

24044 QUARK MODEL AND HIGH-ENERGY SCATTERING. Kokkedee, J. J. J.; Van Hove, L. (CERN, Geneva). Nuovo Cimento (10), 42A: 711-16(Apr. 1, 1966).

The additivity assumption for two-body quark amplitudes is formulated for elastic scattering, and various implications of the assumption for meson and baryon scattering cross sections are outlined. Some new consequences are found which are remarkably analogous to predictions of the Regge-pole model for high-energy scattering. (L.B.S.)

24045 MEAN LIFE OF POSITRONIUM IN LIQUID HELIUM. TEMPERATURE AND DENSITY EFFECT. Manuzio, G. E. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cimento (10), 42B: 341-7 (Apr. 11, 1966).

The mean life of orthopositronium in liquid helium was measured at several densities and temperatures. A model is proposed to reproduce the given experimental results. It is also shown that our model accounts well for the measurements in helium gas, given by other authors. A characteristic temperature effect for the mean lives in gas is predicted. (auth)

24046 STRUCTURE IN π^-p ELASTIC SCATTERING AT 180 DEG. Kormanyos, S. W. (Univ. of Michigan, Ann Arbor); Krisch, A. D.; O'Fallon, J. R.; Ruddick, K.; Ratner, L. G. Phys. Rev. Lett., 16: 709-13(Apr. 18, 1966).

An experiment is described for measuring the differential cross section for π^-p elastic scattering at 180°. This fixed cross section is studied in steps of 100 Mev/c or less, in the region from 1.6 to 5.3 Bev/c. The fixed-angle cross section shows considerable structure which gives information about the properties of various N* resonances. (B.G.D.)

24047 SPIN AND PARITY OF THE N(2190). Yokosawa, A. (Argonne National Lab., Ill.); Suwa, S.; Hill, Roger E.; Esterling, Robert J.; Booth, Norman E. Phys. Rev. Lett., 16: 714-17(Apr. 18, 1966).

An analysis of results obtained from an experiment which measured the differential cross section and polarization in π^-p elastic scattering at incident pion momenta of 1.7, 1.88, 2.07, 2.27, and 2.50 Bev/c is presented. The purpose of this experiment was to examine the bump at a mass of 2190 Mev/c^2 observed in total cross section measurements. The results indicate that at least one partial wave resonates at this mass value, namely $g_{7/2}$. (B.G.D.)

24048 PREDICTION OF A MINIMUM IN THE HIGH ENERGY $\pi + N \rightarrow \omega + N$ DIFFERENTIAL CROSS SECTION. Wang, Ling-Lie (Univ. of California, Berkeley). Phys. Rev. Lett., 16: 756-60(Apr. 25, 1965).

The experimental data for the differential cross sections of $\pi^- + p \rightarrow \pi^0 + n$ show a minimum around $t = -0.6$ (Bev/c)^2 which can be explained by the fact that spin-flip amplitude dominates the spin-nonflip amplitude and the spin-flip amplitude contains a factor $\alpha_\rho(t)$. Thus the major component in the amplitude vanishes when $\alpha_\rho(t) = 0$, producing a minimum in the differential cross section. It is shown that a similar but even more pronounced minimum should appear in the high-energy $\pi + N \rightarrow \omega + N$ differential cross sections. (B.G.D.)

24049 PROTON-DEUTERON ELASTIC SCATTERING AT HIGH MOMENTUM TRANSFERS. Coleman, E.; Heinz, R. M.; Overseth, O. E.; Pellett, D. E. (Univ. of Michigan, Ann Arbor). Phys. Rev. Lett., 16: 761-3(Apr. 25, 1966).

Differential cross section measurements of 1.0- to 2.0-Bev proton elastic scattering on deuterons at high four-momentum transfers are presented. (B.G.D.)

24050 DETERMINATION OF THE BRANCHING RATIOS AMONG THE NEUTRAL DECAY MODES OF THE η PARTICLE. Di Giugno, G. (Univ., Naples); Querzoli, R.; Troise, G.; Vanoll, F.; Giorgi, M.; Schiavon, P.; Silvestrini, V. Phys. Rev. Lett., 16: 767-73(Apr. 25, 1966).

An experiment is described in which the branching ratios among the neutral decay modes of the η particle have been measured using a counter technique. Strong evidence for the presence of the mode $\eta \rightarrow \pi^0 + \gamma + \gamma$ is obtained. (B.G.D.)

24051 PHOTOPRODUCTION OF N* RESONANCES IN THE QUARK MODEL. Moorhouse, R. G. (Stanford Univ., Calif.). Phys. Rev. Lett., 16: 772-4(Apr. 25, 1966).

An examination of the quark model and its consequences for the photoproduction of N* resonances with masses between 1400 and 2000 Mev is presented. It is also shown that the vertex couplings, γNN^*, vanish for certain N* states of the nonrelativistic quark model. (B.G.D.)

24052 COMPARISON OF PION AND ANTIPION LIFETIMES. Bardon, M.; Dore, U.; Dorfan, D.; Krieger, M.; Lederman, L.; Schwarz, E. (Columbia Univ., New York). Phys. Rev. Lett., 16: 775-9(Apr. 25, 1966).

Measurements of the ratio of π^+ to π^- lifetimes are presented. The method is based upon the detection of π-μ decays in flight for pion beams of ~120 Mev/c. (B.G.D.)

24053 MEASUREMENT OF $\pi^{\pm}$p BACKWARD SCATTERING AT 4 TO 8 Gev/c. Brody, H.; Lanza, R.; Marshall, R.; Niederer, J.; Selove, W.; Shochet, M.; Van Berg, R. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett., 16: 828-32(May 2, 1966).

A measurement of the differential cross section is reported for elastic scattering of positive and negative π mesons from hydrogen at 4, 6, and 8 Bev/c, in the angular region of about 140 to 165° c.m., corresponding to a range of u (square of the four-momentum transfer from incoming pion to outgoing proton) roughly from -0.2 to -1.0 (Bev/c)^2. (B.G.D.)

24054 DIRECT MEASUREMENT OF NEUTRON-NEUTRON SCATTERING. Kuchowicz, Bronislaw. Postepy Fiz., 17: 67-9(1966). (In Polish).

An idea was developed for an experimental accomplishment of n-n scattering. The experiment can be realized in cosmic space. The neutron source can be a pulse reactor containing enriched uranium fuel. The detector (an ionization chamber filled with ^{3}He) is shielded from direct neutrons and it can detect only the neutrons scattered on other neutrons from the beam. The calculations are presented for the case of 8.6×10^{17} neutrons per pulse. In this case the background is approximately 18 per cent. (auth)

24055 GLAUBER SHADOW FORMULA. Queen, N. M. (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), 87: 889-96(Apr. 1966).

It is pointed out that the derivation of the Glauber shadow formula for high-energy scattering by deuterons employs the static approximation, in which the nucleons of the deuteron are regarded as fixed in position during the scattering process. An alternative shadow formula which does not involve this approximation is obtained, starting from the double scattering terms of an exact multiple scattering expansion and retaining only certain intermediate states. The new result differs from the standard Glauber formula by the replacement of the parameter $\langle r^{-2} \rangle$, the mean inverse square of the deuteron radius, by another quantity defined in terms of an integral over the deuteron form factor. The relationship between the two results is studied, and it is shown that the difference between them may be significant at all energies. Although certain arguments can be advanced in favor of each of the two versions of the shadow formula, it is suggested that, at least at moderate energies, the new result may be the more accurate one. The analysis of the three-body problem is also extended to deuteron-deuteron scattering. (auth)

24056 ISO-VECTOR PART OF NUCLEON FORM FACTOR. Furuichi, Susum (Rikkyo Univ., Tokyo); Watanabe, Keiji. Progr. Theoret. Phys. (Kyoto), 35: 174-6(Jan. 1966).

The isovector part of the nucleon form factor is calculated by using the $\pi\pi \rightarrow N\bar{N}$ amplitude with contributions from both the correlating and the noncorrelating two-pion state. The consistency of such an amplitude in the nucleon structure is checked by comparison with experimental analyses, and the results are found to be in satisfactory agreement. (L.B.S.)

24057 ELECTROMAGNETIC MASS DIFFERENCE AND THE STRUCTURE OF BARYON AND BOSON. Miyamoto, Yoneji (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 35: 179-80(Jan. 1966).

The structure of elementary particles is considered on the basis of SU(6) theory in which it is assumed that baryons and bosons are composed of fundamental triplets. Relations are obtained for the electromagnetic mass differences of baryons and bosons. Two assumptions are made: that the electromagnetic self-energy of the ur-proton is smaller than those of the ur-neutron and ur-lambda; and that members of the triplets have the charges $\frac{2}{3}$, $-\frac{1}{3}$, and $-\frac{1}{3}$, respectively. (L.B.S.)

24058 MONTE-CARLO BOX FOR K_2^0 DECAYS. I. REST-MASS SYSTEM CONFIGURATIONS. Neagu, D. V. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 997-1018(1965). (In Russian).

It is shown that for the study of the decay properties of the meson (K_2^0) several modeling operations must be accomplished for the experimental conditions, and several arguments are given in favor of the Monte-Carlo method. After a general description of the method, the program for the construction of a statistical box which contains all the possible configurations for meson (K_2^0) decays in the meson rest system is explained in detail. The Monte-Carlo method for simulating registration conditions and identification of meson (K_2^0) decays in the Wilson chamber is described. (tr-auth)

24059 MONTE-CARLO BOX FOR K_2^0 DECAYS. II. LABORATORY SYSTEM CONFIGURATIONS. Neagu, D. V. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 1019-33(1965). (In Russian).

The program for the construction of a statistical box which contains all the possible configurations for meson (K_2^0) decays in the laboratory system and is based on the results obtained in previous work is explained. The imaginary meson (K_2^0) decays are provided with a "passport" which contains the description of the configurations in the laboratory rest system as well as the values of all the parameters which would be obtained experimentally if the events corresponding to the decays were actually registered in the photographs in the track chamber and were suitably treated. (tr-auth)

24060 MUONIUM ATOM. Hughes, Vernon W. Sci. Amer., 214: 93-100(Apr. 1966).

A general discussion of the muonium atom is presented including a physical description, its discovery, tests for existence, chemical stability, magnetic properties and interactions, hyperfine structure interval, and formations of chemical compounds. (B.G.D.)

24061 APPLICATION OF THE CONICAL FUNCTION AND MEAN VALUE THEOREM TO THE PROBLEMS OF SCATTERING. Liu, Yao-yang. Wu Li Hsueh Pao, 21: 1889-96(Nov. 1965). (In Chinese).

Based on the dispersion relation, an approximate method is suggested to obtain the scattering amplitudes. In principle this method can be applied to the study of the amplitude

behavior of low- and high-energy scattering. For high energy $\pi^{\pm}p$, $K^{\pm}p$, and pp scattering, the primary comparison with experiments is made by two parameters. It is found that the theory agrees with experiments. (auth)

24062 ELASTIC HIGH-ENERGY SCATTERING OF PROTONS ON DEUTERONS. Bayukov, Yu. D.; Vorobev, L. S.; Leksin, G. A.; Fedorov, V. B.; Khovanskii, V. D. Yadern. Fiz., 3: 283-9(1966). (In Russian).

The proton-deuteron elastic scattering differential cross sections were measured at the l. s. angle 136.3° for the incident proton energies 715 ($\theta_{cms} - 157.5°$), 1000 ($\theta_{cms} = 160°$) and 3660 Mev ($\theta_{cms} - 165.2°$) and proved to be equal to 26.3 ± 80, 17.7 ± 4.3 and 3.1 ± 3.1 μbarn/ster in the cms, respectively. The results are discussed in the pole diagram approximation with neutron exchange. (auth)

24063 INVESTIGATION OF THE LEPTONIC DECAYS OF K_2^0 MESONS. Anikina, M.; Vardenga, G.; Zhuravleva, M. (and others) (Joint Inst. for Nuclear Research, Dubna, USSR. Inst. of Physics, Academy of Sciences, Georgian SSR). Yadern. Fiz., 3: 316-20(1966). (In Russian).

It follows from the analysis of 816 leptonic decays of K_2^0-mesons, that for constant form factors the leptonic decays are due to the vector interaction. Assuming $\mu - e$ universality the following ratios are obtained for the $K_{\mu 3}$ and K_{e3} decay probabilities: $R = 0.76^{+0.10}_{-0.06}$, and for the form factors: $\xi = f_-/f_+ = 0.8$. (auth)

24064 MEASUREMENT OF THE K_2^0- AND K_1^0-MESON MASS DIFFERENCE. Vishnevskii, M. E.; Galanina, N. D.; Semenov, Yu. A.; Krupchitskii, P. A.; Berezin, V. M.; Murysov, V. A. Yadern. Fiz., 3: 321-6(1966). (In Russian).

The value of the K_2^0- and K_1^0-meson mass difference is obtained by measuring the dependence of the intensity of the coherent regeneration of K_1^0-mesons in a K_2^0-meson beam on the width of the regenerator (copper or aluminum). The K_1^0-mesons are detected according to the decay $K_1^0 \rightarrow \pi^+ + \pi^-$ using a magnetic spectrometer with scintillation counters and spark chambers. The events are distributed with respect to the mass of the decaying particle and the angle between its momentum and the direction of the primary beam. 196 coherently regenerated K_1^0-mesons were observed. The value $\Delta m = 0.82 \pm 0.14$ [$\hbar/\tau_1 c^2$] was obtained. (auth)

24065 PARITY DETERMINATION IN REACTIONS INDUCED BY γ QUANTA. Bilen'kii, S. M.; Ryndin, R. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 332-5(1966). (In Russian).

A method of determining parities in the reactions γ + a + b + c is suggested. The method is based on invariance with respect to reflections in the reaction plane. (auth)

24066 ANALYSIS OF THE DISPERSION RELATIONS FOR COMPTON SCATTERING ON PROTONS. Filkov, L. V. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 3: 336-41(1966). (In Russian).

The kinematical singularities, appearing when simple integrals are singled out from the subtraction-less double dispersion relations for Compton scattering on protons, are taken into account. The imaginary part of the scattering amplitude in the channel III and the additional terms, due to the simple integrals, are calculated in the Born approximation. The connection between the annihilation amplitudes and the amplitudes for π-meson photoproduction on a proton is used to estimate the contribution of states not included in the Born approximation to the imaginary part of the amplitude in channel III. A numerical analysis is performed. (auth)

24067 RESONANCES IN THE $K^0\Lambda$ SYSTEM. Barmin, V. V.; Dolgolenko, A. G.; Erofeev, I. A.; Krestnikov, Yu. S.; Meshkovskii, A. G.; Tikhomirov, G. D.; Trebukhovskii, Yu. V.; Shebanov, V. A. (Inst. of Theoretical and Experimental Physics, State Atomic Energy Commission). Yadern. Fiz., 3: 342-6(1966). (In Russian).

The distribution of 644 $K^0\Lambda$ pairs generated by 2.8 Bev/c π^--mesons in a 17 liter bubble chamber, containing a propane-xenon mixture (H, C, Xe nuclei) or a freon mixture (C, F, Cl nuclei), with respect to the effective mass, were investigated with the purpose of finding resonances in the $K^0\Lambda$ system. No significant irregularities in the $K^0\Lambda$ mass spectrum were found. (auth)

24068 DECAY OF THE f^0 MESON AND OTHER SPIN-2 MESONS IN THE UNITARY SYMMETRY MODEL. Tu, Pham Qui (Kiev State Univ.). Yadern. Fiz., 3: 347-50 (1966). (In Russian).

The decay of the f^0-meson and any other spin 2 mesons into two pseudoscalar mesons are considered in the unitary symmetry model, taking symmetry breaking into account. Relations between the interaction constants of the corresponding decays are obtained. (auth)

24069 PHOTON POLARIZATION EFFECTS IN COMPTON SCATTERING ON RELATIVISTIC ELECTRONS. Neumcke, B.; Meister, H. J. (Univ., Munich). Z. Phys., 192: 162-72(1966).

Photon polarization effects in Compton scattering on unpolarized electrons are calculated in the first Born approximation by using the covariant formalism. The general expressions are specialized with regard to the production of hard γ rays by the scattering of laser photons by relativistic electrons. Results are given for various polarizations of the initial photon and three electron energies in the Bev region. (auth)

24070 RADIATION FIELD OF MULTILAYERED SPHERICALLY SYMMETRICAL SYSTEMS. Barkov, V. I. Zh. Prikl. Spektrosk., 2: No. 6, 534-45(1965). (In Russian).

Various physical examples of a multilayered system with spherical symmetry are indicated, and a formal statement of the problem of determining the emission from spherical multilayered systems for the case of a stationary radiation field and a continuous spectrum is presented. The optical characteristics and the optical-density variation are assumed known for each layer in the system. Each layer is assumed to be in the state of local thermodynamic equilibrium, and the temperature variation in each layer is assumed known. The medium density and medium temperature depend only on the radius of the system. The problem is to find the radiation field in each layer of the system and in the outside space. Only the first stage of the problem, namely the determination of the transport equation, is formulated and its formal solution is found. It is shown that this solution is equivalent to the solution of the Cauchy problem for an assembly of defining functions. The differential equations and initial conditions are derived for these functions. Some properties of these functions are established. (ATD)

24071 THE DIRAC ALGEBRA FOR ANY SPIN. Williams, David N. (Eidgenoessische Technische Hochschule, Zuerich). pp 139-72 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

The spinor calculus and the construction of generalized Pauli matrices for any spin are reviewed, and a few properties of the wave equation and its solution are outlined. The calculation and classification of the analogs of the matrices in the Dirac algebra and the derivation of the relations among them and their traces are considered in detail. (D.C.W.)

24072 COHERENCE AND STATISTICS OF RADIATION. Mehta, C. L. (Univ. of Rochester, N. Y.). pp 345-401 of Lectures in Theoretical Physics. Vol. VII C. Boulder, Colo., Univ. of Colorado Press, 1965.

Some elementary concepts of optical coherence are presented first. More exact and quantitative measures of coherence in terms of second-order coherence functions are then considered together with some applications of such functions. Higher-order coherence phenomena are then discussed. The essential differences between the light from a thermal source and that from a laser are considered. It is shown that second-order coherence functions are completely adequate to describe all the statistical properties of light from a thermal source such as incandescent matter or gas discharges. An introduction to the quantum description of optical coherence is presented,

and it is shown that the quantum description can be reduced to a statistical description under certain conditions. (D.C.W.)

24073 LECTURES ON WEAK INTERACTIONS. Dombey, Norman (Imperial Coll. of Science and Tech., London). pp 402-37 of Lectures in Theoretical Physics. Vol. VII C. Boulder, Colo. Univ. of Colorado Press, 1965.

The theories that have been developed since it was shown that parity is not conserved in weak interactions are outlined starting with a listing of the decay processes that have to be explained or correlated. (D.C.W.)

24074 LECTURES IN THEORETICAL PHYSICS. VOLUME VII B. ELEMENTARY PARTICLES. Lectures Delivered at the Summer Institute for Theoretical Physics, Univ. of Colorado, Boulder, 1964. Brittin, Wesley E.; Marshall, Leona (eds.). Boulder, Colo., Univ. of Colorado Press, 1965. 78p.

Separate abstracts were prepared for 20 of the 22 papers included. The other two papers were previously abstracted for NSA (19: 3030 and 3031). (G.O.Y.)

For abstracts of individual papers see: 24075–24087 and 24168–24174.

24075 EXCITED STATES OF BARYONS. Carruthers, P. (Cornell Univ., Ithaca, N. Y.). pp 82-135 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

Some efforts to obtain a dynamical understanding of the systematic patterns observed in the quantum numbers of baryons and baryon resonances are discussed. The π-N system is considered first, neglecting strange particles completely. The discussion is then generalized to the strange baryons and their resonances. 18 references. (D.C.W.)

24076 DYNAMIC PROPERTIES OF THE Ω^-. Dreitlein, Joseph (Washington Univ., St. Louis). pp 172-82 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

The electromagnetic properties, weak interactions, and strong interactions of the hyperon (Ω^-) are discussed treating the Ω^- as a bound state of a K and a Ξ. (D.C.W.)

24077 THEORETICAL MODELS FOR SIMPLE INELASTIC REACTIONS. Selleri, Franco (Cornell Univ., Ithaca, N. Y.). pp 183-205 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

The dynamical formulation of one-particle-exchange models is discussed with emphasis on the one-pion-exchange model. The problems of calculating the propagators and vertices and of relating the amplitude (XA → CD) with a virtual X to that with a real X, where A and C are nucleons and D and X are pions, are considered in detail. The predictions of the one-pion-exchange model are compared with experimental observations. Absorption effects are also briefly considered. (D.C.W.)

24078 ABSORPTIVE PROCESSES AND SINGLE-PARTICLE EXCHANGE MODELS AT HIGH ENERGIES. Durand III, Loyal; Chiu, Yam Tsi (Yale Univ., New Haven). pp 206-35 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

The changes in the predictions of the single particle exchange models which result from the presence of strong absorption in the initial and final states are investigated. The basic factorization theorem for the partial-wave matrix elements is derived for the case of potential scattering of spinless particles. The formulation is then expanded to include particles with spin. The interactions $\bar{p} + p \rightarrow \bar{\Lambda} + \Lambda$ (K or K* exchange) $\pi^+ + p \rightarrow \rho^+ + p$ are considered as specific examples. (G.O.Y.)

24079 POLE MODEL OF ISOBAR PRODUCTION. Selleri, Franco (Cornell Univ., Ithaca, N. Y.). pp 236-48 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

A pole model for isobar production is proposed. (G.O.Y.)

24080 DIFFRACTION PHENOMENOLOGY: ELASTIC AND INELASTIC PROCESSES IN STRONG INTERACTIONS. Krisch, A. D. (Cornell Univ., Ithaca, N. Y.). pp 249-84 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

The basic nature of diffraction-scattering phenomenology is discussed, and some experimental data and recent phenomenological work are reviewed. An explanation of diffraction phenomena in terms of a simple model for strong interactions is outlined. (D.C.W.)

24081 REVIEW OF RECENT WORK ON K^- MESON INTERACTIONS. Stevenson, M. L. (Univ. of California, Berkeley). pp 285-33 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo.. Univ. of Colorado Press, 1965.

The most recent observations of previously unreported resonances are summarized, as well as the production characteristics of the many outgoing two-body channels in the K^--p system. 71 references. (D.C.W.)

24082 APPLICATIONS OF THE OPTICAL MODEL FOR 2-Bev/c K^- INTERACTIONS. Ayer, F. (Univ. of Colorado, Boulder); Marshall, L.; Oliphant, T. pp 335-42 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

The effectiveness of the optical model in representing elastic and charge-exchange scattering of mesons (K^-) by protons at 2 Bev/c was studied using optical-model codes written for the Klein-Gordon equation and the Schroedinger equation. (D.C.W.)

24083 π-π SCATTERING AND RESONANCES. Selove, W. (Univ. of Pennsylvania, Philadelphia). pp 413-25 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

The feasibility of using the one-pion-exchange model to obtain information on π-π scattering from experimental data is discussed. Some information on π-π resonances is reviewed, and an analysis of data for meson (ρ) production is outlined. (D.C.W.)

24084 POSITIVE-DEFINITE AND COVARIANT SPIN-1 POLARIZATION MATRIX. Zwanziger, Daniel (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). pp 426-32 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

The polarization matrix of a spin-1 particle can be represented by a real traceless symmetric Lorentz tensor D^{uv}. A parametrization of D^{uv} is given that ensures the positivity of the corresponding polarization matrix. As examples, the D^{uv} corresponding to a polarization produced or measured in 3-particle processes and in parity-conserving 4-particle processes are given explicitly. The angular distribution for the decay of a spin-1 particle is also expressed explicitly in terms of D^{uv} and the 4-vector amplitude that describes the decay process. (G.O.Y.)

24085 RELATIVISTIC QUANTUM THEORY OF ROTATIONAL STATES. Corben, H. C. pp 433-44 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press 1965.

The rotational states of a spinning particle are investigated relativistically. The results of some calculations using relativistic quantum mechanics are compared with the experimentally observed spectra of baryons and mesons. (D.C.W.)

24086 REMARKS ON A FORMULA FOR THE MESON MASSES. Brown, Laurie M. (Northwestern Univ., Chicago). pp 449-55 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

Some predictions and experimental comparisons are made on the basis of a one-parameter formula for the masses of mesons that are members of SU(3) octets. (G.O.Y.)

24087 REVIEW OF THE π-NUCLEON EXPERIMENTAL SITUATION AND ITS PHASE-SHIFT INTERPRETATION. Perez-Mendez, V.; Roper, L. David (Univ. of California, Berkeley and Livermore). pp 457-72 of Lectures in Theo-

retical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

The types of experimental data that are available for the phase-shift analysis of the π-N interaction up to incident energies of 1 Bev are briefly reviewed. Energy-dependent phase-shift analyses are briefly discussed, and the results of some phase-shift analyses are compared. (D.C.W.)

24088 1965 MIDWEST CONFERENCE ON THEORETICAL PHYSICS MEETING HELD AT THE OHIO STATE UNIVERSITY, JUNE 14–15, 1965. Columbus, Ohio, Ohio State University, 1965. 261p. (CONF-650542).

Separate abstracts were prepared for 12 of the 13 papers included. The other paper was previously included in NSA(15: 1172). (G.O.Y.)

For abstracts of individual papers see: 24089–24091, 24113, 24114, and 24281, 24382–24387.

24089 PERIPHERAL PRODUCTION AND DECAY OF RESONANCES. Jackson, J. D. (Univ. of Illinois, Urbana). pp 44-9 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

Some research on decay correlations and the peripheral model with absorptive effects is briefly discussed. 17 references. (D.C.W.)

24090 STRONG COUPLING IN STATIC MODELS. Goebel, C. J. (Univ. of Wisconsin, Madison). pp 63-77 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

Models that describe a system consisting of a meson field coupled to an infinitely massive scatterer are discussed in the limit in which the Yukawa meson-scatterer coupling constant becomes infinitely large. Analyticity theory (Chew-Low formalism) is used instead of field theory. (D.C.W.)

24091 UNIFIED MODEL OF BARYONS AND LEPTONS. Moffat, J. W. (Univ. of Toronto). pp 90-104 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

A unified description of the baryons and leptons is presented using the SU(4) group. (D.C.W.)

Field Theory, Scattering Theory, and Symmetries

See also Elementary Particles and Radiations

Refer also to abstracts 24259, 24263, 24380, and 24537.

24092 (CERN-65-24(Vol.3), pp 1-41) SU_3 AND SU_6 SYMMETRY OF STRONG INTERACTIONS. Van Hove, L. (European Organization for Nuclear Research, Geneva (Switzerland)).

Various discussions are presented on SU(3) and SU(6) symmetry: three-dimensional spinor calculus, the group SU(3) and its representations; the main multiplets of hadrons; infinitesimal transformations, operators for isospin and hypercharge; transformation of operators under SU(3); mass splitting operator, mass formula of Gell-Mann and Okubo; electromagnetic properties, U spin; coupling between baryons and pseudoscalar mesons; nonrelativistic spin and the group SU(2); the group SU(6); SU(6) multiplets of hadrons; and SU(6) predictions for baryon interactions. (M.O.W.)

24093 (IC–66/38) CHIRAL GROUP WITH A NEW USE OF ITS REPRESENTATIONS. Taylor, J. C. (International Centre for Theoretical Physics, Trieste (Italy)). Apr. 1966. 13p. Dep. mn.

A new approach to the chiral group SW(3) is proposed. All particles are assumed to be massless in the limit of exact symmetry. Different helicity states of the same physical particle may then be assigned to different SW(3) representations. For example, 0^- mesons and zero helicity 1^- mesons are put together in (8,1) + (1,8), but helicity ± 1 vector mesons go in $(3,3^+) + (3^+,3)$. For collinear processes there is a unique frame for defining helicities, and therefore a unique extrapolation to nonzero mass. Assuming the symmetry still approximately valid, several SU(6) results are recovered, including the ratio of magnetic moments. (auth)

24094 (IC-66/39) SATURATION OF U(3) ⊗ U(3) ALGEBRAS AT INFINITE MOMENTUM TRANSFER Oehme, R. (International Centre for Theoretical Physics, Trieste (Italy)). Apr. 1966. 16p. Dep. mn.

The saturation of the current algebras of chiral and collinear U(3) ⊗ U(3) is explored. The set of states consists of the octet and the decimet of baryons. The matrix elements of the commutators of current densities with the corresponding charges are evaluated at infinite momentum and finite, orthogonal momentum transfer. In the case of collinear U(3) ⊗ U(3), the infinite momentum is parallel to the direction specified by the algebra. The results are the same for both algebras. They are not consistent with those obtained from collinear U(6)-symmetry. In particular, the f- and d-components of the Pauli magnetic form factors vanish for all values of q^2, and the vector part of the decimet-octet transition matrix element is zero at $q^2 = 0$. The problem of admixtures is discussed only briefly. (auth)

24095 (IC–66/40) A HIGH-ENERGY THEOREM BY ALGEBRA OF CURRENTS. Okubo, S. (International Centre for Theoretical Physics, Trieste (Italy)). Apr. 19, 1966. 11p. Dep. mn.

The algebra of currents theory is used to derive a high-energy theorem for Compton scattering of the nucleon. This theorem may be used, in addition, to distinguish the validity of various elementary particle models. (M.O.W.)

24096 (N–65-33253) INTRODUCTION TO QUANTUM ELECTRODYNAMICS. Epstein, Saul T. (Wisconsin Univ., Madison. Theoretical Chemistry Inst.). May 5, 1965. 65p. (NASA-CR–64636; WIS-TCI–93). CFSTI $3.00 cy, $0.75 mn.

A series of four lectures on quantum electrodynamics is presented. The dynamic variables that characterize the electromagnetic field are described first, and an example is given for the application of quantum-mechanical methods to field theory. The destruction and creation operators for photons and momentum polarization are then developed, and interactions with charged particles are introduced. The spontaneous emission of light by a bound system is also discussed, and the photoelectric effects in hydrogen due to one quantum are calculated. Finally, the Thomson formula for the scattering of light by a charged particle is derived. (D.C.W.)

24097 (NYO-3399-34) $\tilde{U}(12)$ AND UNITARITY. Balachandran, A. P. (Syracuse Univ., N. Y. Dept. of Physics). [1965]. Contract AT(30-1)-3399. 27p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The consequences of applying unitarity to the $\tilde{U}(4)$ invariant scattering amplitude of a $\tilde{U}(4)$ quartet baryon and a $\tilde{U}(4)$ singlet meson are studied in detail. A simple proof is presented to show that if the total amplitude is invariant under the group, then there is no scattering. It is proved by explicit construction that if invariance is insisted upon only for a finite number of partial waves, then there is no contradiction with unitarity alone. However, there is a correlation between these waves which implies that some of the phase shifts vanish at threshold at a rate faster than that required by the finite range of the forces. If invariance is retained for all partial waves, this correlation is compatible with the existence of a partial-wave expansion only if there is no scattering. It is also shown that if $\tilde{U}(4)$ is applied only at zero kinetic energy, then with some additional, but reasonable assumptions, one can derive an infinite number of linear equations which relate different partial-wave scattering lengths. The technique developed in this connection should be useful also in analyzing more realistic scattering processes. The different interpretations of the $\tilde{U}(12)$ symmetry which have been proposed are examined, and it is suggested that it is perhaps an in-

variance group only of three-point functions as there does not seem to be any inconsistency between the $\tilde{U}(12)$ invariance of a three-point function and its unitary structure. A proof is constructed to show that for processes like $\pi^+\pi^- \to \pi^+\pi^-$ and $\pi^0\pi^0 \to \pi^0\pi^0$, the scattering lengths for sufficiently large, even angular momenta are strictly positive. More generally, the scattering length associated with the analytically continued, even-signature partial wave is positive for all sufficiently large, real angular momenta. (auth)

24098 (UCRL-11998) ON THE CONNECTION BETWEEN THE CONFORMAL GROUP AND THE ULTRAVIOLET SINGULARITIES IN QUANTUM FIELD THEORY. Kastrup, H. A. (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 15, 1965. Contract W-7405-eng-48. 36p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The hypothesis that the ultraviolet singularities of quantum field theory are connected with conformal invariance at very high energies is investigated, and it is demonstrated that the singularities can be removed in an elementary way. The main point is that a whole class of new and independent solutions of the field equation is connected with the conformal group. These solutions cannot be described within the framework of the usual test function class S of the distribution calculus. But it is possible to define new test functions which are appropriate for dealing with these new solutions and their essential singularity on the light cone. In the quantum field theory of the Klein-Gordon equation, one now obtains two sets of creation and annihilation operators, the second of which belongs to the new solution. The metric of the Hilbert space concerned is semidefinite and degenerate. It also turns out that the vacuum is infinitely degenerate. But the secondary vacua have a vanishing norm. As an immediate consequence of the semi-definite metric the mass-independent singularities on the light cone of the generalized Green's function cancel each other. (auth)

24099 (UCRL-14127) QUANTUM ELECTRODYNAMICS ON A COMPUTER. Schulz, William D. (Lawrence Radiation Lab., Univ. of California, Livermore). Apr. 23, 1965. Contract W-7405-eng-48. 15p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The possibility of solving a field theory on a computer is considered using quantum electrodynamics as a model. It is shown that in a proper machine calculation, renormalization can be ignored. A fully quantized formulation of the electromagnetic field which has no renormalization difficulties is presented. (D.C.W.)

24100 (UR-875-79) A NOTE ON A DIFFICULTY WITH THE $\tilde{U}(12)$ S-MATRIX THEORY. Riazuddin; Pandit, L. K.; Okubo, S. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). Mar. 24, 1965. Contract AT(30-1)-875. 10p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The noncompact group $\tilde{U}(12)$ was earlier proposed as a relativistic generalization of SU(6). The possibility that $\tilde{U}(12)$ invariance and crossing symmetry of the S-matrix may not be compatible is discussed. (M.O.W.)

24101 ELECTROMAGNETIC PROPERTIES OF HADRONS IN THE STATIC SU_6 MODEL. Thirring, W. (Univ., Vienna). Acta Phys. Austr., Suppl. II, 205-11(1965).

The static SU(6) model which assumes that the quark interaction is spin- and unitary spin-independent and that there are no orbital contributions to the magnetic moments is discussed. The state vectors of the physical particles are drawn regarding their spin and quark content. Expectation values μ which is the magnetic moment measured in quark magnetons, δm_0 which corresponds to a mass difference of the quarks with $|Q| = 1/3$ and $2/3$, δm_e which is the electrostatic interaction and should be multiplied with e^2/R where R is a mean distance of quarks, and δm_m which is the magnetic interaction are presented for all of the hadrons. (B.G.D.)

24102 RESTRICTION ON MODELS OF VERY HIGH ENERGY SCATTERING. Zalewski, Kacper (Inst. of Physical Chemistry, Krakow). Acta Phys. Pol., 29: 255-7 (Feb. 1966).

It was found that a variety of models yields unitary S matrices corresponding to plausible assumptions about inelastic scattering and to an elastic differential cross section of the right shape. It is suggested that if a model assumes that the elastic partial-wave amplitude S_l is real, it should also assume that it is non-negative, $S_l \to 0$. This condition is found to be more restrictive in some cases than that pointed out by Bialas and Van Hove. Application is made to a simple model where two final channels are open for two particles in the initial channel: the elastic channel and an inelastic two-body channel. (L.B.S.)

24103 ON THE BOUND STATE OF THREE PARTICLES. Zakharev, B. N.; Kalinauskas, R. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Ann. Phys. (7), 16: 305-11 (1965).

The expansion of the function Ψ of three particles interacting with each other via the potentials V_{12}; V_{13}; V_{23} in a complete set of the functions describing the motion of two particles coupled by a finite potential well V_{12} (the complex particle) is considered. It is shown that in this expansion the population of the highest virtual states decreases with energy as $\sim 1/\epsilon_n^3$. The system of integral differential equations for the bound state of three particles can be cut off (with $\epsilon_n > \epsilon_s$, where ϵ_s is rather large, may be neglected). (auth)

24104 ON THE EXISTENCE OF THE FIELD OF OPERATORS IN THE AXIOMATIC QUANTUM FIELD THEORY. Wizimirski, Z. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 14: 91-3(1966).

It was previously shown by Wightman that the field of type $M^4 \ni x \to B(x) \in L(H)$, which is covariant under Lorentz translations and fulfils the postulate of locality, cannot be used in axiomatic quantum field theory, because if only the usual spectral condition is fulfilled, the creation operators cannot be constructed from B(x) and B*(x). It is shown that if the field is covariant under the whole inhomogeneous Lorentz group, then such a field must be trivial (i.e., it must have the property $B(x)\Omega = k\Omega$, $k \in C$, where x is the space time point and Ω is the vacuum state) even if it is not local and the spectral condition is not fulfilled. (L.B.S.)

24105 TEMPERED DISTRIBUTIONS IN INFINITELY MANY DIMENSIONS. I. CANONICAL FIELD OPERATORS. Kristensen, P.; Mejlbo, L.; Poulsen, E. Thue (Univ. of Aarhus, Denmark). Commun. Math. Phys., 1: 175-214(1965).

The space of testing functions for tempered distributions is characterized in an abstract way as the maximal space in a certain class of locally convex topological vector-spaces. The main characteristic of this class is stability under the differentiation and multiplication operators. The ensuing characterization of tempered distributions may readily be generalized to the case of infinitely many dimensions, and a certain class of such generalizations is studied. The spaces of testing elements are required to be stable under the action of the canonical field operators of the quantum theory of free fields, and it is shown that extreme spaces of testing elements exist and have simple properties. In fact, the maximal space is a Montel space, and the minimal complete space is a direct sum of such spaces. The formalism is applied to the problem of extending the canonical field operators, and a number of extension theorems are derived. (auth)

24106 ON THE STRUCTURE OF THE VON NEUMANN ALGEBRAS GENERATED BY LOCAL FUNCTIONS OF THE FREE BOSE FIELD. Langerholc, J.; Schroer, B. (Univ. of Pittsburgh). Commun. Math. Phys., 1: 215-39 (1965).

It is shown that the von Neumann algebra $R_{\mathfrak{B}}(B)$ generated by any scalar local function B(x) of the free field $A_0(x)$ is equal either to $R_{\mathfrak{B}}(A_0)$ or to $R_{\mathfrak{B}}(:A_0^2:)$. The latter statement holds if the state space $\mathfrak{H}_B$ obtained from the vacuum state by repeated application of B(x) is orthogonal to the one-particle subspace. In the proof of these statements, space-time limiting techniques are used. (auth)

24107 PROOF OF THE CROSSING PROPERTY FOR TWO-PARTICLE AMPLITUDES IN GENERAL QUANTUM

FIELD THEORY. Bros, J. (CEN, Saclay, France); Epstein, H.; Glaser, V. Commun. Math. Phys., 1: 240-64 (1965).

The crossing property is proved on the mass shell for amplitudes involving two incoming and two outgoing stable particles with arbitrary masses. Any couple of physical regions in the (s, t, u)-plane corresponding to crossed processes are shown to be connected by a certain domain of analyticity. For every negative value of t, the amplitude is analytic in the cut s-plane outside of a large circle. (auth)

24108 GEOMETRIC QUANTIZATION. Souriau, J. M. (Faculte des Sciences, Marseille). Commun. Math. Phys., 1: 374-98(1966). (In French).

The usual quantization of a system with n degrees of freedom is not independent of the choice of coordinates and treats time on a special footing. In order to obtain an intrinsic quantization procedure, the phase space Φ and the set V of classical motions are first considered separately, which are partially set in correspondence, at each time t, by solving an initial values problem, but are nevertheless not identifiable. If the dynamical variables are defined as functions on V, Poisson's theorem defines the Poisson bracket as an internal operation on these dynamical variables; this allows V to be equipped with a structure of a 2n-dimensional symplectic manifold, which follows from coordinate independent variational considerations. This symplectic structure allows not only the quantization program to be stated intrinsically but also gives an intrinsic realization. With this purpose, a bundle space W is constructed with basis V ("the quantizing bundle space"); the physical states are functions defined on W; to each classical dynamical variable corresponds an infinitesimal motion of W, inducing an observable of the states; thus a "quantization" fulfilling the commutation relations and the evolution equations. Since this construction uses merely the symplectic structure of V, the (local) isomorphisms of this structure can be locally lifted (along local isomorphisms of the bundle space W); the invariance groups of the system therefore acts canonically on the states, up to a phase; thus the usual projective representation of these groups, without any supplementary postulate. The results of the geometrical quantization are compared with the usual quantization procedure, taking as examples the harmonic oscillator and the hydrogen atom; wider states spaces are found (due to the fact that all the dynamic variables are represented); but a general rule related to "quantal measurements" allows the spectral values, e.g., of the energy to be restricted to the familiar ones. The case of the free relativistic particle is treated in details; the method there provides a state on which the Poincaré group acts projectively; by reduction of this representation, one gets spaces of complex waves functions, verifying the usual wave equations for all integer spin values. The investigation of momentum, energy and angular momentum yields natural results. The application of the method to field quantization notably of general relativity is outlined. (auth)

24109 SU(6) SYMMETRY IN STRONG AND ELECTROMAGNETIC EXCHANGE REACTIONS OF ELEMENTARY PARTICLES. Kadysevskij, V. G.; Muradjan, R. M.; Smorodinskij, Ja. A. Fortschr. Phys., 13: 599-646(1965). (In German).

The development of SU(6) symmetry theory was briefly reviewed as an introduction to the description of the theory itself. The representation of the SU(3) group mass formulas in the SU(3) group, magnetic moments and electromagnetic fission SU(3), SU(6) symmetry in the space of spin and unitary spin, irreducible representations of the SU(6) group, 35-dimension multiplet mesons, 56-dimension multiplet of baryons, mass formulas in SU(6), magnetic moments in SU(6), and electromagnetic mass fission in 56-dimension multiplet are described. (J.S.R.)

24110 THE AXIOMATIC APPROACH TO QUANTUM FIELD THEORY. Todorov, I. T. Fortschr. Phys., 13: 649-700(1965). (In German).

A representation of the basic principles and results of the axiomatic approach to relativistic quantum theory is given. Auxiliaries from functional analysis and the theory of distribution invariants with respect to the inhomogeneous Lorentz group and the the principle of spectrality, definition and properties of local quantum fields, definition and properties of Wightman functions, reconstruction of the space of the state vectors and the field operators for the Wightman functions, the Hall and Wightman theorem and its applications, asymptotic conditions and the s matrix, Borcher equivalence classes, and the generalized free fields are discussed. (J.S.R.)

24111 GENERALIZED AND REDUCIBLE FREE FIELDS IN FOCK SPACE. Streit, L. (Eidgenoessische Technische Hochschule, Zurich). Helv. Phys. Acta, 39: 65-70(1966).

In the Fock space $H_{m,0}$ generated from the vacuum by a mass m, scalar free field not all the free fields are irreducible (and hence equivalent). The reducible and the generalized covariant free fields in $H_{m,0}$ are constructed and some of their properties are discussed. (auth)

24112 ASYMPTOTIC PHASE AND AMPLITUDE FOR A MODIFIED COULOMB POTENTIAL IN SCATTERING THEORY: AN APPLICATION OF INVARIANT IMBEDDING. Beyer, W. A. (Los Alamos Scientific Lab., N. Mex.). J. Math. Anal. Appl., 13: 348-60(Feb. 1966).

The application of invariant imbedding to the asymptotic behavior ($t \to \infty$) of the solutions to $d^2w/dt^2 + (1 - 2\eta/t - L(L+1)/t^2)w = f(t)w$, where $\int^\infty |f(t)|dt < \infty$ as a function of the initial conditions $w(x) = \cos\theta$, $w'(x) = \sin\theta$ for $x > 0$ is given. This differential equation is the partial wave Schroedinger equation with Coulomb potential (the quantity $-2\eta/t$). A representation of the asymptotic phase and amplitude for this problem is derived. (J.F.P.)

24113 BORN SERIES IN GENERALIZED POTENTIAL SCATTERING. Tani, S. (New York Univ., New York). pp 26-43 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

The conditions on the potential under which the analytical continuation can be made straightforwardly starting with the Born series are discussed together with the approximation methods in which one can take full advantage of the analytic property of the Born series as a function of the potential strength. (D.C.W.)

24114 GROUP OF THE STRONG COUPLING THEORY AND HIGHER SYMMETRIES. Sakita, B. (Argonne National Lab., Ill.). pp 78-89 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

The group of the strong coupling, which is the semi-direct product of a semi-simple invariance group with an Abelian group whose generators are the meson currents, is discussed in detail. Various symmetries (from SU(2) to SU(6)) are used for the semi-simple invariance group and are interrelated. (G.O.Y.)

24115 EQUIVALENT VECTOR FIELDS. Pocsik, G. (Roland Eoetvoes Univ., Budapest). Nucl. Phys., 80: 691-3(1966).

By means of the asymptotic condition it is shown that starting from a vector field of nonvanishing divergence one can introduce a spin-one vector field without changing the four-momentum operator nor the S-matrix. (auth)

24116 STRONG INTERACTIONS AT HIGH ENERGIES. Harun Ar Rashid, A. M. Nucl. Sci. Appl., 1: 48-65(Dec. 1965).

A review of some of the theoretical problems of current interest and some of the models suggested to deal with strong interactions at high energies is presented. (B.G.D.)

24117 UNITARY SYMMETRIES. Choudhury, A. Latif (Univ. of Dacca, Pakistan); Harun Ar Rashid, A. M. Nucl. Sci. Appl., 1: 66-103(Dec. 1965).

In elementary particle physics, the use of group theory started with the introduction of the concept of isotopic spin. The isotopic spin is described by the formalism of the group SU(2). The discovery of SU(3) came with the spur of finding of the hyperons Λ, Σ, and Ξ and the theoretical pre-

diction of a new internal quantum number, hypercharge. A discussion of recent SU(6) developments is presented along with the development of the noncompact group U(12). (B.G.D.)

24118 GENERALIZED CAUCHY REPRESENTATIONS AND RESONANCE PHENOMENA. Dilley, J. (Ohio Univ., Athens). Nuovo Cimento (10), 42: 717-29(Apr. 21, 1966).

It is well known that if the analytically continued partial-wave scattering amplitude has a pole lying near the physical region, then a resonance occurs in the region $E \simeq E_R$, where $E_n = E_R + i\gamma$ is the position of the pole. In practical calculations, the scattering amplitude can be approximated by a single-pole term $f_1(E) = \beta_n g(E_n, E)/(E - E_n)$ in the resonance region, where β is the residue of $f_1(E)$ and $g(E', E)$ is an arbitrary analytic function of E' and E such that $g(E',E) = 1$. The fact that many choices of the function $g(E',E)$ are possible leads to an ambiguity in the representation. The relationship between the observed amplitude and the corresponding pole parameters is discussed, and it is shown that for a class of "good representations," the position, height, and width of the resonance are independent of the choice of g to order γ^2/E_R^2. The corresponding situation for complex angular representations using Regge trajectories is also discussed. (auth)

24119 GAUGE GROUPS AND NOETHER'S THEOREM. Dass, Tulsi (Univ. of Delhi). Nuovo Cimento (10), 42: 730-6(Apr. 21, 1966).

Implications of Noether's theorem in the case of gauge groups are investigated. Apart from the usual conservation laws, a gauge group relates the conserved four-vectors to the divergence of certain antisymmetric tensors whose definition is also supplied by the gauge group. In some cases these four-vectors vanish identically. Precise conditions under which this happens and therefore no conservation law is implied by the gauge group are obtained. The statement of Lopez that a gauge group implies a conservation law only when it contains a phase group as a subgroup is shown to be incorrect. A counter-example is also given. (auth)

24120 NONDYNAMICAL METHODS TO DETERMINE PARITIES AND TO TEST INVARIANCE PRINCIPLES. Csonka, P. L.; Moravcsik, M. J.; Scadron, M. D. (Univ. of California, Livermore). Nuovo Cimento (10), 42: 743-56 (Apr. 21, 1966). (UCRL-14341-T).

All following considerations are independent of dynamics. Four simple theorems are proved concerning experiments that can determine intrinsic parities of particles or experiments that can test the validity of invariance under space reflection, time reversal, and (assuming the CPT theorem) charge conjugation. The last two of these invariance principles are discussed only for elastic reactions. It is shown, among other things, that both parity determination and testing of invariance principles are essentially impossible in reactions involving more than four particles, and are possible in four-particle reactions essentially only if some spin information is obtained about all participating particles. (auth)

24121 SHELL MODEL OF HADRONS BASED ON HIGHER SYMMETRIES. Malyuta, Yu. M. (Inst. of Physics, Kiev). Nuovo Cimento (10), 42: 782-96(Apr. 21, 1966).

Shell models of hadrons are proposed, based on higher symmetries. The supermultiplet structure is investigated, and mass formulas are obtained for the lowest configurations in jj and LS schemes. (auth)

24122 ISOBAR PRODUCTION IN HIGH-ENERGY NUCLEAR INTERACTIONS. Peak, L. S.; Woolcott, R. L. S. (Cornell Univ., Ithaca, N. Y. Univ. of Sydney). Nuovo Cimento (10), 42: 856-70(Apr. 21, 1966).

For nucleon-nucleon collisions at a median energy of 5000 Bev, the median fraction of the energy released by the fireball process was measured as $K_F = 0.25 \pm 0.03$. Also the total fraction of energy released by the interaction was determined as $K = 0.45^{+0.05}_{-0.10}$. The significant discrepancy is attributed to the release of energy by the isobar decay process. (auth)

24123 FIELD-THEORY PROOF OF LEVINSONS THEOREM. Deshpande, N. G.; Gujadhur, T. K. (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 42: 894-900(Apr. 21, 1966).

The field-theory proof of Levinson's theorem given by Charap is examined, and the reason for the apparent disagreement with the dispersion-theory proof of Warnock is pointed out. It is shown that the two proofs are, in fact, not referring to the same C.D.D. poles. Attention is also drawn to a certain assumption on linear independence of parameters in the field-theory proof, and an example is given where this assumption leads to wrong behavior of the phase shift. (auth)

24124 IMPROVEMENT OF THE GREENBERG-LOW BOUND. Martin, A. (CERN, Geneva). Nuovo Cimento (10), 42: 901-7(Apr. 21, 1966).

It is shown that the Greenberg-Low upper bound on the scattering amplitude $|F(s, \cos\theta = 1)| < s^2 \log^2 s$, which is derived from the axiomatic analyticity domain of the scattering amplitude, can be replaced by $\int (\mathrm{Im}\, F(s, \cos\theta = 1)/s^3)\, ds$ convergent and $|F(s, \cos\theta = 1)|/|s|^2 \to 0$ for $s \to \infty$, $\epsilon < \mathrm{Arg}\, s < \pi - \epsilon$. Further it is shown that the polynomial boundedness condition inside the Lehmann ellipse can be replaced by the weaker condition $|F(s, \cos\theta = 1 + C/s^2)| < \exp |s|^\alpha$ with $\alpha < 1/6$. (auth)

24125 EXTENSION OF THE AXIOMATIC ANALYTICITY DOMAIN OF SCATTERING AMPLITUDES BY UNITARITY. [PART] I. Martin, A. (CERN, Geneva). Nuovo Cimento (10), 42: 930-53(Apr. 21, 1966).

It is shown first that any scattering amplitude satisfying fixed transfer dispersion relations for $-t_0 < t \leq 0$ is in fact analytic in the topological product $|t| < R \times s$ in the cut plane with cuts $s = C + \lambda$, $s = -t - \mu + C'$, $\lambda, \mu \geq 0$. R is some fixed number. For the pion-pion case, $R = 4\mu^2$ where μ is the pion mass. For pion-pion scattering the domain is extended further by using elastic unitarity. The region of validity of dispersion relations is a certain domain in the t-plane, which contains in particular the real segment $t = -28\mu^2$ to $t = 4\mu^2$. The fixed energy sections of the amplitude for not too high energies contain part of the Mandelstam cuts. In particular in the elastic region the analyticity domain of the absorptive part contains part of the Mandelstam double-spectral function. The domain thus obtained is not yet a natural domain both from the pure analytic completion point of view and from the unitarity condition. The investigation is being continued. (auth)

24126 MASS FORMULA FOR THE MESON MULTIPLET (6,6) IN $U_2 \otimes U_6$ SYMMETRY. Fayyazuddin; Rashid, M. A. (Atomic Energy Center, Lahore). Nuovo Cimento (10), 42: 1000-3(Apr. 21, 1966).

Assuming that the nine pseudoscalar mesons π, K, η, X and the nine vector mesons ρ, K*, ω, φ constitute the $(6,\bar{6})$ representation, as was previously suggested, an analysis of the symmetry breaking for the multiplet is carried out on the lines employed earlier by Harari and Rashid. (L.B.S.)

24127 MASSLESS PARTICLES RATHER THAN SPURIOUS STATES FOLLOWING BROKEN SYMMETRY. Katz, A.; Frishman, Y. (Weizmann Inst. of Science, Rehovoth, Israel). Nuovo Cimento (10), 42: 1009-11 (Apr. 21, 1966).

The usual proofs of the Goldstone theorem show that a broken symmetry entails a point in the excitation spectrum at energy and momentum both equal to zero. The question of whether this point indicates a branch in the spectrum with energy tending to zero together with the momentum or whether it is the contribution of a spurious state is considered. It is shown within the framework of general field theory that the former possibility is realized and that zero-mass excitations actually occur. (L.B.S.)

24128 MESON-BARYON SCATTERING: CORRECTIONS TO THE BOOTSTRAP POLE APPROXIMATIONS.

De Maria, M.; Taglienti, B. (Univ., Rome). Nuovo Cimento (10), 42: 1012-14(Apr. 21, 1966).

Dispersion relations are written for the independent amplitudes in a static octet model for the baryon-meson interaction, in the limit of exact SU_3 symmetry. It is investigated, within the framework of the fixed-source model used by Hara, whether the corrections due to the contribution of all other scattering amplitudes introduce any substantial change in the results obtained by keeping only the contributions of the states belonging to the {8} and {10} representations. It is found that within a wide range of variation for the parameters of the theory (D/F ratio and width γ_{10} of the resonance) the corrections are indeed small and the $(3/2)^+$ decuplet remains the only resonant state. The corrections are minimized by the values of the parameters given by the bootstrap solutions. (L.B.S.)

24129 IMPOSSIBILITY OF HAVING THE EXACT U_6 GROUP BASED UPON ALGEBRA OF CURRENTS. Okubo, S. (International Atomic Energy Agency, Trieste, Italy). Nuovo Cimento (10), 42: 1029-34(Apr. 21, 1966).

Various theorems are presented and proved, which indicate that the U_6 or W_6 group cannot be exact symmetries from the viewpoint of current algebra, and that they must be regarded as broken symmetries at best. (L.B.S.)

24130 LITTLE-GROUP AND MEAN-SPIN OPERATOR FOR HIGHER-SPIN EQUATIONS. Zaman, Arif Uz (Middle East Technical Univ., Ankara). Nuovo Cimento (10), 42A: 478-92(Apr. 1, 1966).

The connection between the little-group operators and the Foldy-Wouthuysen mean-spin operators was investigated for fields of arbitrary spin with Bargmann-Wigner type equations. It is shown that the equivalence of these two operators proved recently for the Dirac equation holds within a similarity transformation for the Wigner-Bargmann type fields, and precisely for a certain set of free fields having one spinorial index and other indices transforming as a unitary Wigner representation. The Lorentz invariance of the free-field equations is proved. (auth)

24131 THE DISCONTINUITY OF A GENERAL FEYNMAN INTEGRAL AND REGGE POLES IN PERTURBATION THEORY. Hamprecht, B. (Univ. of Cambridge, Eng.). Nuovo Cimento (10), 42A: 493-515(Apr. 1, 1966).

A formula for the complete discontinuity across the cut of an arbitrary Feynman integral is derived. One-variable dispersion relations for a certain range of the other variable are established. Mellin transforms are extended to Feynman integrals with indefinite coefficients of s and t in the Feynman denominator. This extension is nontrivial. Finally a method is derived that allows treatment of the leading asymptotic behavior in terms of Legendre functions instead of only in terms of powers of the variable going to infinity. It is shown that in all cases in which a leading $(-t)^{\alpha_j(s)}$ behavior was obtained for a class of Feynman integrals summed, a Regge pole can explicitly be shown to exist in the Regge plane. The pole structure in the Regge plane is shown to be simpler than the one in the α-plane. (auth)

24132 BEHAVIOR FOR LARGE κ OF THE S-MATRIX FOR STRONGLY SINGULAR POTENTIALS. Limic, N. (International Atomic Energy Agency, Trieste, Italy). Nuovo Cimento (10), 42A: 516-25(Apr. 1, 1966).

The exact asymptotic behavior of the S-matrix for fixed λ and large κ in the right half of the κ-plane is obtained in the case of the scattering on strongly singular potentials. (auth)

24133 LORENTZ-INVARIANT VARIABLES FOR n-PARTICLE SYSTEMS. Michael, C. (Clarendon Lab., Oxford). Nuovo Cimento (10), 42A: 526-36(Apr. 1, 1966).

A choice of Lorentz-invariant angle variables for an n-particle system is described. They are applied to the boundary of the physical region, to the phase space volume element, and to the singularity structure of Feynman graphs. (auth)

24134 THE OFF-SHELL STRUCTURE OF THE PARTIAL T MATRIX IN POTENTIAL SCATTERING. Guennegues, J. Y. (Faculte des Sciences, Orsay, France). Nuovo Cimento (10), 42A: 549-64(Apr. 1, 1966).

For the usual superpositions of Yukawa potentials, the partial off-shell two-particle T-matrix, $T_l(k,k',p)$ is expressed in terms of the solution of the Schrödinger equation and its analytic properties are studied with respect to the energy (p) and the initial (k) and final (k′) momenta. T_l is shown to be equal to a meromorphic term, separable in k and k′, plus a nonseparable but analytic part containing the Born approximation. For this purpose, use is made of a nonsingular integral equation deduced from the operational form of the Lippmann-Schwinger equation, by taking its matrix elements between a ket of the momentum representation and a bra of the co-ordinate representation. (auth)

24135 DYNAMICAL REARRANGEMENT OF SYMMETRIES. II. THE COMPLEX SCALAR FIELD. Nakagawa, K. (Univ., Naples. Istituto Nazionale di Fisica Nucleare, Naples); Sen, R. N.; Umezawa, H. Contract AF 61(052)-826. Nuovo Cimento (10), 42A: 565-88(Apr. 1, 1966).

The Goldstone model of a complex scalar field with a biquadratic interaction term in the Lagrangian is studied in the pair approximation. It is found that a zero-mass particle, the Goldstone particle, exists in the symmetry-breaking solution, and that the original symmetry of the theory rearranges itself into the gauge invariance of the massless field. The viewpoint adopted is that of dynamical maps which allows the theory to be developed clearly and unambiguously, while doing away with the Heisenberg, Schrödinger and interaction representations. (auth)

24136 MASS BREAKING IN $\tilde{U}_{12}$. Rivers, R. J. (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 42A: 593-605(Apr. 1, 1966).

Because the $\tilde{U}_{12}$ degeneracy is badly broken experimentally several authors introduce an ad hoc mass splitting between the SU_3 multiplets within the external $\tilde{U}_{12}$ multiplets in calculations of scattering amplitudes in an inhomogeneous $\tilde{U}_{12}$ theory. It is shown that if this mass splitting is consistently extended to internal particle exchange higher-order spurion amplitudes are introduced which, in regions of the energy variables near SU_3 masses, are likely to give important contributions to the amplitudes. The form of these is exhibited for pole diagrams. Restricting ourselves to the elastic scattering of SU_3 multiplets in the forward direction for pole diagrams it is found that in many cases the $\tilde{U}_{12}$ predictions for the amplitudes are unaltered. A prescription is given for the general case. (auth)

24137 HOMOGENEOUS FUNCTIONS AS A BASIS OF UNITARY REPRESENTATIONS OF GROUPS SL(n, C). Ruehl, W. (CERN, Geneva). Nuovo Cimento (10), 42A: 619-38(Apr. 1, 1966).

A set of homogeneous functions that form a basis for unitary irreducible representations of groups SL(n,C) is constructed. The connection with the theory of Gel'fand and Neumark is studied. (auth)

24138 A DYNAMICAL CALCULATION OF THE WEAK AXIAL VECTOR CURRENT F/D RATIO. Diu, B. (CERN, Geneva); Van Royen, R. P. Nuovo Cimento (10), 42A: 649-55(Apr. 1, 1966).

The Dashen-Frautschi perturbation technique is applied to the weak axial vector current of baryons, with the result that it transforms like an octet member and that its F/D ratio is approximately $1/2$. (auth)

24139 MODIFIED SPACE-TIME DERIVED FROM NON-EUCLIDEAN MOMENTUM SPACE. Cicogna, G. (Scuola Normale Superiore, Paris). Nuovo Cimento (10), 42A: 656-71(Apr. 1, 1966).

The result of introducing a fundamental length in space-time is obtained by treating momentum space as a primitive structure, and giving it a de Sitter metric. The ensuing properties of space-time are discussed, showing that a consistent treatment of particle equations is still possible, in spite of the lack of commutativity of its Cartesian coordinates. A modified form of the Klein-Gordon equation is explicitly given. The group of motions of momentum

space, i.e., the de Sitter group, is also discussed, and its representations are used in order to reveal the peculiar kind of quantization of space-time, which results from this approach. (auth)

24140 HIGH-ENERGY RELATIONS FOR SCATTERING OF PARTICLES AND ANTIPARTICLES WITH ARBITRARY SPIN FOLLOWING FROM ANALYTICITY AND CROSSING RELATIONS. Bialas, A.; Svensson, B. E. Y. (CERN, Geneva). Nuovo Cimento (10), 42A: 672-94 (Apr. 1, 1966).

Using analyticity and crossing relations for helicity amplitudes in two-body elementary-particle reactions proceeding via strong interaction, the connection between the high-energy asymptotic expansions of these amplitudes in the direct and the crossed reaction is derived. This connection is simple and generalizes in a straightforward way the corresponding relation for spinless particles. Besides allowing a proof of Pomeranchuk-type theorems for differential cross sections and polarizations, the result constitutes a very convenient parametrization of the helicity amplitudes, useful in the theoretical analysis of two-body experiments at high energy. (auth)

24141 SHMUSHKEVICH PRINCIPLE AND CURRENT ALGEBRA. Watanabe, K. (Dublin Inst. for Advanced Studies). Nuovo Cimento (10), 42A: 707-10(Apr. 1, 1966).

An investigation was made of the connection between the static bootstrap condition leading to the Shmushkevich principle and the current commutator algebra, following examples given by Ryan. A set of equations were obtained from which the values of the effective coupling constants were determined. A one-to-one correspondence was found between the Shmushkevich principle and the current commutator algebra, except for the ambiguity in the sign of the axial vector coupling constant. (L.B.S.)

24142 SYSTEMS OF IMPENETRABLE BOSONS AND FERMIONS WITH SPIN 1/2 IN ONE DIMENSION. Bocchieri, P.; Miglietta, F. (Univ., Pavia, Italy. Istituto Nazionale di Fisica Nucleare, Pavia, Italy). Nuovo Cimento (10), 42B: 193-8(Apr. 11, 1966).

It is proved that, in the one-dimensional case, a system of N hard-core fermions with spin $\frac{1}{2}$ has energy eigenvalues coinciding with those of a system of N hard-core bosons or fermions without spin. (auth)

24143 STATIONARY STATES IN QUANTUM FIELD THEORY. Rosen, Gerald (Drexel Inst. of Tech., Philadelphia). Phys. Rev. Lett., 16: 704-6(Apr. 18, 1966).

A report is presented on a Rayleigh-Ritz procedure for functionalities that can be used to obtain approximate stationary states in quantum field theory. Functionalities are defined as rules that assign a (real or complex) number to a (real or complex) functional. (B.G.D.)

24144 ALGEBRA OF CURRENTS AND NONLEPTONIC HYPERON DECAY. Brown, Lowell S.; Sommerfield, Charles M. (Yale Univ., New Haven). Phys. Rev. Lett., 16: 751-2(Apr. 25, 1966).

An attempt is made to clarify an assumption made by Suzuki (Phys. Rev. Letters 15: 986(1965)) and Sugawara (Phys. Rev. Letters 15: 870, 997(1965)) in recent investigations of S-wave nonleptonic hyperon decay amplitudes, within the framework of the algebra of currents. This assumption concerns the extrapolation of the decay amplitudes to an unphysical point where the four-momentum of the pion vanishes. (B.G.D.)

24145 CONSISTENCY CONDITION ON G_A AND D/F FROM CHIRAL SU(3) ⊗ SU(3). Bincer, Adam M. (Univ. of Wisconsin, Madison). Phys. Rev. Lett., 16: 754-6 (Apr. 25, 1966).

Two approaches using the chiral SU(3) ⊗ SU(3) algebra generated by the time components of the vector and axial-vector currents to calculate the renormalization of the axial-vector coupling constant are considered. The differences between the purely algebraic method and the dispersion-theoretic technique are discussed. (B.G.D.)

24146 RELATIVISTIC WAVE EQUATIONS AND LAGRANGIAN FIELD THEORY FOR ARBITRARY SPIN. Tung, Wu-Ki (Yale Univ., New Haven). Phys. Rev. Lett., 16: 763-6(Apr. 25, 1966).

The fundamental difference in the frame work of field theory between particles of spin 0, $\frac{1}{2}$, and 1 and particles with higher spins is discussed. The main ideas behind the development of relativistic wave equations and Lagrangian field theory which can be extended for higher spin cases are presented. (B.G.D.)

24147 GOLDSTONE'S THEOREM AND APPROXIMATE SYMMETRIES IN STRONG INTERACTIONS. Strocchi, F. (Princeton Univ., N. J.). Phys. Rev. Lett., 16: 822-4 (May 2, 1966).

The assumptions that the state $|Q> \equiv Q|0>$ (where $|0>$ is the vacuum state and Q is a generalized charge which generates some approximate symmetry of strong interactions) is a normalized state and that the automorphism induced by Q can be described by a unitary operator V exp (iQα), which leaves the vacuum invariant is shown to be inconsistent with the breaking of the symmetry and has to be dropped, unless one is prepared to have massless particles. (B.G.D.)

24148 APPLICATION OF NONINVARIANCE GROUPS TO MESON-BARYON SCATTERING. Kuriyan, Jacob G.; Sudarshan, E. C. G. (Syracuse Univ., N. Y.). Phys. Rev. Lett., 16: 825-7(May 2, 1966). (NYO-3399-62).

The structure of scattering amplitudes is considered within the noninvariance-group framework, and several relations are deduced between different amplitudes which include the Johnson-Trieman relations and the Olsson relation but extend their domain of validity. The connection between this framework and the groups of strong and intermediate coupling meson theories are established. The results obtained are independent of the specific representation to which the baryons are assigned. (B.G.D.)

24149 POSSIBLE UNIFICATION OF TWO-BODY INTERACTION OF NON-LEPTONIC DECAY AND MASS-SPLITTINGS ON THE BASIS OF CABIBBO SPACE INVARIANCE. Imoto, Mitsuo (Nihon Univ., Tokyo); Furui, Shin-ya; Kawasaki, Shoichiro. Progr. Theoret. Phys. (Kyoto), 35: 172-4(Jan. 1966).

It is noted that the form of the nonleptonic decay hamiltonian for two-body weak interactions is bilinear similarly to mass terms, and moreover, that both the nonleptonic decay hamiltonian and the mass splittings are SU_3-breaking, and are described with similar tensor elements of the same 8-dimensional representation. Taking these features into account, the possibility is suggested that these SU_3-breaking terms are unified into an invariant form in a subspace defined by Cabibbo's condition on leptonic decay. (L.B.S.)

24150 DYNAMICAL SYMMETRY IN PARTICLE PHYSICS. Pais, A. (Rockefeller Inst., New York). Rev. Mod. Phys., 38: 215-55(Apr. 1966).

A review is given of recent applications of symmetry arguments in particle physics. It deals with the developments which start with SU(6). (auth)

24151 ASYMPTOTIC BEHAVIOR OF THE SCATTERING AMPLITUDE FOR POTENTIAL AND FIELD-THEORETICAL SCATTERING. Lomsadze, Yu. M.; Tokar, S. S. (Uzhgorod State Univ., USSR). Ukr. Fiz. Zh., 11: 133-41 (Feb. 1966). (In Ukrainian).

Proceeding from previous results the asymptotic behavior of the partial wave amplitude $\alpha_\lambda(l,s)$ as $s \to \infty$ for scattering by the physical potentials of type $\lambda\int_m^\infty d\mu\sigma(\mu)\, e^{-\mu r}/r^p$ is obtained. The dependence of the location $l^{lead}(0)$ of the leading Regge trajectory on the degree of singularity of the potential at zero is also obtained. The maximum strong interaction corresponding to $l^{lead}(0) = 1$ turns out to be non-achievable though any close approach to it is possible. An analytical continuation into the complex n-plane is carried out for the coefficient function $u_n(j,s)$ coinciding in the case of $n = 0, 1, 2, \ldots$ with the coefficient of the nth term of the perturbation series for the field-theoretical partial wave amplitude $a_\lambda(j,s) \equiv \sqrt{s} f_\lambda(j,s)$ ($\lambda = g_a^2$ and g is

the physical coupling constant). For the case of renormalizable theories connection is established between the asymptotic $a_\lambda(j,s)$ as $s \to \infty$ and the extreme right-hand singularity $u_\lambda(j,s)$ in the n-plane — the connection which may be trivially extended to the case of total amplitude $T_\lambda(s,t)$. (auth)

24152 ELASTIC AND INELASTIC FORM FACTORS IN THE CROSS SECTIONS OF ELECTROMAGNETIC PROCESSES. Baier, V. N.; Fadin, V. S.; Khoze, V. A. (Novosibirsk State Univ.). Yadern. Fiz., 3: 327-31(1966). (In Russian).

General formulas for the cross sections of elastic scattering and the two- and three-particle annihilation of a pair of arbitrary particles are derived in the one-photon approximation. The creation of a pair of particles in interactions of photons with charged particles and in the inelastic electromagnetic annihilation of a pair is considered. (auth)

24153 STRUCTURE OF RELATIVISTIC CURRENTS IN THE SU(6) SYMMETRY. Golfand, Yu. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 3: 351-8(1966). (In Russian).

A system of nine relativistic currents $W_{\alpha\mu}$, satisfying a certain boundary condition, following from the SU(6) symmetry, is constructed. The boundary condition determines the form of the currents up to a common form factor. The obtained currents are written as the sum of a polar and an axial vector. Possible applications to weak and electromagnetic interactions are considered. A number of relations for nucleon electromagnetic form factors and baryon magnetic moments are obtained. (auth)

24154 COUPLING CONSTANTS FOR THE MULTIPLETS 56, 56* AND 35 OF THE SU(6) GROUP AND THE SU(3) x SU(3) SYMMETRY. Volkov, D. V.; Gurev, V. N. Yadern. Fiz., 3: 359-65(1966). (In Russian).

All possible relations between the coupling constants of particles belonging to the multiplets 56, 56*, and 35 of the group SU(6) are considered, assuming that the breaking of SU(6) symmetry is kinematical and is connected with the existence of two-independent-particle momenta in the vertex functions describing the interaction. (auth)

24155 NEW DEFINITION OF TRANSLATIONS IN THE SYMMETRY GROUP ISL(6). Kadyshevskii, V. G.; Todorov, I. T. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 366-71(1966). (In Russian).

A natural extension of the translation subgroup is suggested, so as to avoid the difficulties in writing down invariant equations in the ISL(6)-group theory. The new momenta are defined as the set of all third order minors of the translation generator matrix in ISL(6). They transform according to the representation D(20,20) of SL(6) and contain only one Lorentz four-vector which is also an SU(3) singlet. The analog of the Dirac equation is a system of first order equations, invariant with respect to reflections, for a 40-component bispinor, transforming according to the representation D(20,1) + D(1,20). (auth)

24156 INTEGRAL REPRESENTATION OF RELATIVISTIC AMPLITUDES IN THE NON-PHYSICAL REGION. Kuznetsov, G. F.; Smorodinskii, Ya. A. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 3: 383-95 (1966). (In Russian).

Methods of integral geometry are used to obtain the expansion of amplitudes in the nonphysical parts of the Mandelstam plane in terms of the eigenfunctions of the Laplace operator on three-dimensional manifolds. Formulas are obtained for the inverse transformation. All calculations are performed in the spherical coordinate system. (auth)

24157 RELATIONS BETWEEN POLARIZATION EFFECTS IN PARITY-CONSERVING PROCESSES. Dubovikov, M. S. (Moscow Inst. of Physics and Tech.). Yadern. Fiz., 3: 396-400(1966). (In Russian).

Relations between polarization effects in parity conserving processes are obtained. Additional relations for identical particles are considered. (auth)

24158 INTRODUCTION TO AXIOMATIC FIELD THEORY. Tomozawa, Yukio (Inst. for Advanced Study, Princeton, N. J.). pp 438-88 of Lectures in Theoretical Physics. Vol. VII C. Boulder, Colo., Univ. of Colorado Press, 1965.

The basic structure of the Wightman approach to axiomatic field theory is explained. The properties of vacuum expectation value of the product of field operators in Wightman theory, such as the analyticity and symmetry properties, which are the consequences of the axioms assumed in the theory, are also discussed. (G.O.Y.)

24159 LECTURES IN THEORETICAL PHYSICS. VOLUME VII A. LORENTZ GROUP. Lectures Delivered at the Summer Institute for Theoretical Physics, Univ. of Colorado, Boulder, 1964. Brittin, Wesley E.; Barut, Asim O. (eds.). Boulder, Colo., Univ. of Colorado Press, 1965. 392p.

Separate abstracts were prepared for each of the 18 papers included. (G.O.Y.)

For abstracts of individual papers see: 24071, 24160–24167, and 24247–24255.

24160 ANALYTICITY, COMPLEX, AND QUATERNIONIC LORENTZ GROUPS AND INTERNAL QUANTUM NUMBERS. Barut, A. O. (Univ. of Colorado, Boulder). pp 121-31 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

The problem of the enlargement of the Poincaré group is discussed. Examples of nontrivial enlargements and group-theoretical models for broken symmetry are given. In particular, the inhomogeneous complex Lorentz group of the first kind is treated in detail whose representations give a correct description of spin and isospin and leads to a mass spectrum. Furthermore, the inhomogeneous quaternionic Lorentz group (both in complex and quaternionic Hilbert space) is discussed, whose 12-parameter little group is large enough to contain ordinary spin and, in the limiting case, an approximate symmetry such as U_3. (auth)

24161 COMPLEX ANGULAR MOMENTUM AND THE REPRESENTATIONS OF THE POINCARE GROUP WITH SPACE-LIKE MOMENTUM. Joos, H. (Deutsche Elektronen Synchrotron DESY, Hamburg). pp 132-8 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

It is shown that the formal application of a Racah technique for the Poincaré group to the products of field operators may be used to introduce fields which "carry complex angular momentum." Use is made of the formal similarity of the 3-dimensional Lorentz group to the rotational group. (G.O.Y.)

24162 ON STAPP'S THEOREM. Minkowski, Peter; Williams, David N.; Seiler, Rudolf (Eidgenoessische Technische Hochschule Zuerich). pp 173-89 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

A few points concerning the proof of Stapp's theorem on holomorphic, Lorentz-covariant functions are discussed. (G.O.Y.)

24163 INVARIANT AMPLITUDES FOR MASSLESS PARTICLES AND UNIVERSAL ELECTROMAGNETIC COUPLING. Zwanziger, Daniel (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). pp 190-224 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

The n-dimensional spinor calculus is developed and is applied to amplitudes involving massless particles. Light-like spinors are introduced, and spinorial representations of the Lorentz group corresponding to massless particles are derived. Multipole fields or spinor spherical harmonics for massless particles of arbitrary spin are found. Four-particle scattering amplitudes involving one or two

massless particles are considered. They are decomposed into a minimum number of linearly independent invariant amplitudes that are free of kinematical singularities. The three-particle scattering amplitudes are expressed in terms of coupling constants, and a particularly simple amplitude is proposed as the S-matrix statement of minimal electromagnetic coupling of charged particles of arbitrary spin. (auth)

24164 CROSSING RELATIONS OF HELICITY AMPLITUDES FOR PROCESSES WITH PARTICLES OF HIGHER SPIN. Muzinich, I. (Univ. of Washington, Seattle). pp 244-58 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

The crossing relations of two-body scattering amplitudes for reactions involving massive particles with spin are derived for the helicity amplitudes of Jacob and Wick. The crossing relations are then given for the invariant spinor functions (M functions) introduced by Stapp and Joos. And from the crossing relations for the M functions, the crossing relations for the center-of-mass helicity amplitudes are derived. The crossing relations are expressed in terms of unitary matrices which are elements of the little group. Finally, two theorems are proven from the crossing relations which relate the polarization and the differential cross section to the center-of-mass helicity amplitude for the crossed process. (G.O.Y.)

24165 ANALYTIC PROPERTIES OF VACUUM EXPECTATION VALUES OF PRODUCTS OF FIELD OPERATORS. Islam, Jamal N. (Univ. of Maryland, College Park). pp 259-84 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

The preliminary results of a study of the analytical properties of the vacuum expectation values of products of field operators that follow from the assumptions of Lorentz invariance, no negative-energy states, and local commutativity are presented. (D.C.W.)

24166 ANALYTIC PROPERTIES OF THE PARTIAL WAVE AMPLITUDES FOR PRODUCTION PROCESSES IN THE COMPLEX J-PLANE. Barut, A. O.; Leung, Y. C. (Univ. of Colorado, Boulder). pp 285-94 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

The analytic properties of the partial-wave amplitudes for production processes in the complex angular momentum plane are investigated. Some general features are found. (G.O.Y.)

24167 HAMILTON-CAYLEY THEOREM FOR MATRICES WITH NON-COMMUTATIVE ELEMENTS. Ilamed, Yehiel (Soreg Research Establishment, Yavne, Israel). pp 295-6 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

The Hamilton-Cayley theorem for matrices with non-commutative elements is presented. (G.O.Y.)

24168 BOOTSTRAP MODELS AND INTERNAL SYMMETRY. Capps, Richard H. (Northwestern Univ., Evanston, Ill.). pp 1-23 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

A discussion of exact and inexact internal symmetry in bootstrap models is presented. The problem of mass splitting is considered in some detail. (D.C.W.)

24169 BARYONIC STATES AND A TEST OF THE BOOTSTRAP HYPOTHESIS. Martin, Arthur W. (Argonne National Lab., Ill.). pp 24-35 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

Some models are discussed in which the interdependence of the 1405-Mev Y* and the resonant octet is emphasized. A test of the bootstrap hypothesis is outlined. (D.C.W.)

24170 SU_3 REACTION PREDICTIONS AND SYMMETRY BREAKING. Meshkov, Sydney (National Bureau of Standards, Washington, D. C.). pp 36-50 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

The predictions of SU(3) symmetry for a number of meson-proton interactions involving baryon resonances were compared with experimental data. It was found that the predictions of pure SU(3) invariance are badly violated for the U-spin qualities. (D.C.W.)

24171 UNITARY SYMMETRY AND WEAK INTERACTIONS. Lee, Benjamin W. (Univ. of Pennsylvania, Philadelphia). pp 51-81 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

The transformation properties of the weak-interaction Lagrangian for both leptonic and nonleptonic processes are discussed in the context of SU(3) symmetry. (D.C.W.)

24172 CROSSING RELATIONS, UNITARITY, AND THE PREDICTION OF SYMMETRIES. Martin, Arthur W. (Stanford Univ., Calif.). pp 136-43 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

An attempt is made at predicting symmetries from the requirements of crossing relations and unitarity alone using the two-channel static model solved by Wilson and Wanders. It is concluded that, in this model, crossing relations and unitarity do not lead to the prediction of symmetries. (G.O.Y.)

24173 RESTRICTIONS IMPOSED BY UNITARITY AND ANALYTICITY ON THE BEHAVIOR OF SCATTERING AMPLITUDE AT HIGH ENERGY. Kinoshita, Toichiro (Cornell Univ., Ithaca, N. Y.). pp 144-71 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

A review of the restrictions imposed by analyticity and unitarity on the behavior of the scattering amplitude is presented. Upper and lower bounds of the scattering amplitude, bounds for the slope of the scattering amplitude at $\theta = 0$, the positiveness of the absorptive part A(s,t) in the range $0 \leq t \leq 4$ m^2, and restrictions on the slope of the Pomeranchuk trajectory are considered. 44 references. (D.C.W.)

24174 REMARKS ON THE GROUP STRUCTURE OF CORBEN'S WAVE EQUATIONS. Barut, A. O. (Univ. of Colorado, Boulder). pp 446-8 of Lectures in Theoretical Physics. Vol. VII B. Boulder, Colo., Univ. of Colorado Press, 1965.

The group-theoretical interpretation of the equations of Corben's relativistic quantum theory of rotational states is pointed out together with some difficulties associated with them. (G.O.Y.)

Fluid Physics and Thermodynamics

See also Plasma Physics and Thermonuclear Processes

Refer also to abstract 24572.

24175 (AD-624506) ELECTROHYDRODYNAMIC FLOW OVER A WAVY WALL. Kuwabara, S. (Cornell Univ., Ithaca, N. Y. Graduate School of Aerospace Engineering). June 1965. Contract AF-AFOSR-399-64. 118p. (AFOSR-65-1768). CFSTI $4.00 cy, $0.75 mn.

The electrohydrodynamic flow of a simple, isothermal gas without dissipative effects over a wavy wall is investigated by the perturbation method. The unperturbed flow has a uniform velocity and nonuniform distributions of density and electric field which vanish at infinity. For the subsonic flow, the surface pressure the stream lines and the electric-field lines are calculated. For the supersonic flow, the linearized solution diverges at infinity. This seems to be due to the non-uniform density distribution of the undisturbed flow. Numerical solutions of an oscillating-piston problem, which is a simplified model for the high supersonic flow, are obtained. Some related problems are also investigated. (TAB)

24176 (AD-624563) ELECTROFLUID HYPERSONIC RESEARCH. Quarterly Report No. 1. Zivi, S. M. (TRW Systems, Redondo Beach, Calif. Physical Electronics Lab.). July 23, 1965. Contract AF33(615)-2118. 23p. CFSTI $1.00 cy, $0.50 mn.

Some research on the feasibility of producing a continuous hypersonic flow of air by the electrostatic acceleration of frozen air particles with the subsequent vaporization of the particles is discussed. (D.C.W.)

24177 (AD-624667) A FREDHOLM INTEGRAL EQUATION SOLUTION FOR VARIABLE CONDUCTIVITY MAGNETOHYDRODYNAMIC CHANNEL FLOW [Thesis]. Young, Jimmie Don (Tennessee Univ., Knoxville). Dec. 1965. Contract AF33(608)-1281. 112p. CFSTI $4.00 cy, $0.75 mn.

An approximate solution for the velocity profile in MHD channel flow with an arbitrary variation of conductivity is presented. The approximate method is verified by comparing approximate solutions to exact solutions for the same parameters. (D.C.W.)

24178 (AD-625268) LORENTZ INVARIANCE, MOMENTUM-ENERGY TENSORS, AND THE MHD PROBLEM. Edelen, Dominic G. B. (RAND Corp., Santa Monica, Calif.). Nov. 1965. Contract AF49(638)-700. 46p. (RM-4763-PR). CFSTI $2.00 cy, $0.50 mn.

There has long been controversy as to the correct form of the momentum-energy tensor and of the force law and/or the current vector in general formulations of magnetohydrodynamic problems. An attempt is made to clarify the various questions involved, and two alternative methods of procedure are presented by which internally consistent, physically well-set formulations can be obtained. The major emphasis is on the Hamiltonian approach in terms of Lorentz invariance. (TAB)

24179 (AD-625938) MAGNETOGASDYNAMIC HYPERCRITICAL FLOWS WITH SHOCKS. Annual Summary Report. Geffen, Nima (Technion-Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering). May 1965. Contract AF-EOAR-78-64. 38p. CFSTI $2.00 cy, $0.50 mn.

Two dimensional, steady, non-dissipative magnetogasdynamic flow around given slender bodies is investigated in the hypercritical (near A sq + M sq = 1) approximation. Similarity parameters are obtained by a simple method. and the flow over a double-wedge is formulated in the physical and in the hodograph planes. Two methods of solution are proposed, and a procedure for a digital computer given. (auth)

24180 (AD-627885) ASYMPTOTIC INTEGRATION OF THE EQUATION GOVERNING MAGNETOHYDRODYNAMIC FLOW WITH ALIGNED VELOCITY AND MAGNETIC FIELDS. Berger, S. A. (RAND Corp., Santa Monica, Calif.). Jan. 1966. Contract SD-79. 25p. (RM-4788-ARPA). CFSTI $1.00 cy, $0.50 mn.

The planar flow of an infinitely conducting fluid moving in such a way that the velocity and magnetic fields are always aligned can be analyzed by means of the hodograph technique. The partial differential equation for the stream function in hodograph variables is linear and may be solved by separation of variables. One of the two resulting ordinary differential equations is immediately solvable in terms of trigonometric functions; the other is, for general values of the adiabatic exponent, a second-order linear differential equation with very complicated variable coefficients. The asymptotic behavior of the solutions of this latter equation for large values of the separation constant is obtained. The asymptotic expansion of the derivative of the solution is also given explicitly. The results reduce to the well-known asymptotic forms of the Chaplygin function and its derivative when the magnetic field is set equal to zero. (auth)

24181 (AD-627919) ON MAGNETOHYDRODYNAMICS OF ROTATING FLUIDS. Schwiderski, Ernst W.; Lugt, Hans J. (Naval Weapons Lab., Dahlgren, Va.). Dec. 1965. 72p. (NWL-1962). CFSTI $3.00 cy, $0.75 mn.

The influence of rather general electromagnetic forces acting upon steady rotating motions of conducting viscous incompressible fluids over a rotating disk is investigated by means of adjustable local boundary layer approximations of first order. Numerical results for the most important motions of von Karman and Bodewadt are displayed and discussed in full detail. The hypothesis of small variations of the imposed magnetic field assumed in other investigations is found to be justified provided the corresponding Hartmann number and magnetic Reynolds number are of sufficiently small magnitude. Considerable distortions of the rotating motions result from strong electromagnetic forces. When the strength of the imposed electromagnetic forces is increased, the secondary motions may change their stagnation character to wake character, and vice versa. In addition to critical Reynolds numbers, critical Hartmann numbers and magnetic Reynolds numbers are shown to exist beyond which no simple boundary-layer-type motions are possible. The interpretation of the spacial instabilities of wake-type flows as a separation phenomenon is supported by the "tea-cup" experiment photographed. (auth)

24182 (JPL-TR-32-871) SUB-ALFVENIC FLOW IN A DUCT WITH A NONUNIFORM MAGNETIC FIELD. Peyret, Roger (Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena). Apr. 15, 1966. Contract NAS7-100. 19p.

The flow of a conducting fluid in a duct through a nonuniform magnetic field of the following type is considered: for $x < 0$, the field is uniform and parallel to the axis 0x of the duct; for $x > 0$, the field is nonuniform and the magnetic lines are slightly curved, so that it is possible to use a small-perturbation theory. Moreover, the magnetic Reynolds number R_m and the Alfvén number A are assumed small. One calculates the flow field, then the induced magnetic field. It is found that the disturbances which are propagated upstream decay exponentially for the flow and algebraically for the magnetic field. (auth)

24183 (LA-DC-7806) PRESSURE OSCILLATIONS INDUCED BY FORCED CONVECTION HEATING OF DENSE HYDROGEN. Thurston, R. S.; Rogers, J. D. (Los Alamos Scientific Lab., Univ. of California, N. Mex.); Skoglund, V. J. (New Mexico Univ., Albuquerque). [1966]. Contract W-7405-eng-36. 32p. (CONF-660605-1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

For Presentation at Cryogenic Engineering Conference, Boulder, Colo.

Pressure oscillations of a thermal-acoustic nature with predictable frequencies are discussed. The understanding of these oscillations is extended by establishing a limiting condition for the computation of acoustic frequencies, a correlation for correction of the computed frequencies, and correlations for the inception and amplitude of oscillations. The nondimensional correlation of conditions for the inception of thermal-acoustic oscillations is based on original data for hydrogen in a straight ¼-in. tube. However, it applies to other fluids and geometries, including the data of Platt and Wood for liquid oxygen in ¾-in. coils. At low subcritical pressures two-phase properties are used in the correlations. Near the critical pressure the correlations employ quasi two-phase properties based on considerations of the liquid and gaseous behavior of hydrogen in this region. The characteristics of fluid temperature and flow rate fluctuations accompanying thermal-acoustic oscillations are presented. (auth)

24184 (NP-15954) INVESTIGATION OF A LOW-PRESSURE PENNING DISCHARGE. Rijnhuizen Report 66-28. Schuurman, W. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Mar. 1966. 98p. Dep. mn.

A Penning discharge is a gas discharge in a chamber formed by a cylindrical anode and two cathode plates opposite to each other, immersed in an axial magnetic field. A number of aspects of the Penning discharge are analyzed for one type of geometry (long anode cylinder) and for low pressure ($p < 10^{-4}$ torr). The motion of electrons in crossed electric and magnetic fields was analyzed.

Formulas, derived by previous authors, for the first Townsend coefficient α and for the systematic velocity v_E parallel to the electric field E are based upon unrealistic assumptions. It is investigated how α and v_E will change if these simplifying assumptions are not made. The breakdown characteristics are considered. The existing theory for a cylindrical magnetron discharge is applied to the Penning discharge. Next, the various discharge modes are analyzed. It starts with a classification and a short description of modes, followed by an exposé of the different types of discharge characteristics to be found when gas pressure, anode voltage and magnetic field strength are varied. Extensive treatments are given of the most important modes at low pressure, one at low magnetic field (LMF), the other at high magnetic field (HMF). After a survey of experimental data concerning the LMF-mode, a theory is given, based on Poisson's equation and the continuity equation for electrons. The latter equation is provided with expressions for the kinetic parameters of the electrons, α and ν_i. Incidentally, a formal evaluation of current-voltage characteristics is sketched, in which α and ν_i are still arbitrary. The limits of this mode, viz the extinction at low magnetic field and the transition to the HMF-mode, are described and calculated. The HMF-mode is dealt with in an analogous way. Unfortunately, instabilities seriously limit the validity of a theoretical model based on stable operation of the discharge. The diocotron or slipping stream instability is effective in the whole existence region of the discharge. Nevertheless, some useful results can be obtained with the theory. The basic equations for the anode sheath and the structure of this sheath are investigated. A formula is derived for the ion density in the sheath. This formula predicts values in good agreement with experimental data. Although at very low pressure the ion density may be neglected it plays a dominant part in the transition to the high-pressure mode. The experimental data are presented. (M.O.W.)

24185 (TID–22735, pp 109-52) PLASMAS AND CONTROLLED NUCLEAR FUSION. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Results of plasma heating investigations are presented. Theoretical effort devoted to plasma stability is discussed. Information is included on excitation of ions at ion cyclotron frequencies, beam-plasma discharges, energy gain by mirror collisions in traveling waves, plasma boundary dynamics, hot-electron plasma decay in magnetic-mirror machines, first adiabatic invariant corrections, electron beam instabilities, and applied physics related to controlled nuclear fusion. (J.R.D.)

24186 ELECTRICAL OUTPUT FROM CLOSED LOOP MPD EXPERIMENT USING AUXILIARY IONIZATION. Bienert, W. B.; Young, W. H.; Zavodny, E. N. (Martin Co., Baltimore). Advance. Energy Conver., 6: 25-8 (Jan.-Mar. 1966).

Measurements of the gas conductivity in an MPD generator at a gas temperature of 1000°K are described. Helium seeded with cesium was ionized by a d-c electric arc which increased the conductivity by four orders of magnitude above the thermal equilibrium value. In the presence of a magnetic field an open circuit voltage of 62v was measured compared to 65v theoretical and a maximum short circuit current of 0.03 amp. The resulting V-I curve was linear indicating that no enhancement due to magnetically induced ionization occurred. (auth)

24187 LASER PUMPING BY INTENSE DISCHARGES IN z-PINCH GEOMETRY. Buser, Rudolf G.; Ramm, Dietolf (Army Electronics Command, Fort Monmouth, N. J.). Appl. Opt., 5: 627-31(Apr. 1966).

Optical properties of high-current, low-pressure, noble-gas discharges in z-pinch geometry are studied and compared with theta-pinch discharges and standard commercial light sources. Results indicate possible usefulness in systems where high peak power, high repetition rates or high uv content are demanded. (auth)

24188 MEASURED TANGENTIAL ELECTRODE FORCES FOR AN ARC IN A TRANSVERSE MAGNETIC FIELD. Aisenberg, S.; Rohatgi, V. (Space Sciences, Inc., Waltham, Mass.). Appl. Phys. Lett., 8: 194-6 (Apr. 15, 1966).

The results are described of preliminary measurements of tangential electrode forces on the cathode and anode electrodes for a 77-amp d-c arc in argon in a transverse magnetic field. It was found that the forces on the electrodes were not negligible but were as large as 24% of the force driving the plasma. Unexpected threshold and saturation effects were also found. (L.B.S.)

24189 MATHEMATICAL STUDY OF RELATIVISTIC FLUID THERMODYNAMICS. Lichnerowicz, Andre (College de France, Paris). Commun. Math. Phys., 1: 328-73(1966). (In German).

The existence and uniqueness theorems for the Cauchy problem of relativistic hydrodynamics are proved, in the case of a thermodynamical perfect fluid corresponding to the assumptions of A. H. Taub. The case of a charged fluid, with zero conductivity, in a electromagnetic field is also discussed. The main tool used is Leray's theorem for strictly hyperbolic systems and it is shown by two different methods that it is possible to deduce, from the system of the field equations, a Leray system. In one of the methods, the vorticity tensor occurs and the relativistic Helmholtz equations are deduced for both the charged and uncharged fluids. (auth)

24190 DRAG AND HEAT EXCHANGE IN A LAMINAR CONDUCTING FLUID FLOW IN A TUBE IN A TRANSVERSE MAGNETIC FIELD. Novikov, I. I. Izmeritel. Tekh., No. 1, 32-3(Jan. 1966). (In Russian).

Using previously derived formulas for determining the thickness of the laminar magnetohydrodynamic boundary layer formed by the deflection of a thin film by a plane-parallel current of a conducting liquid in a transversal field and for determining the local resistivity coefficient, c, of the film, the Nusselt number and c were calculated for the case of laminar flow in a tube under otherwise similar conditions. The formula obtained indicates that application of the magnetic field may cause either the increase of the resistivity coefficient with increasing tension of the magnetic field or an initial decrease followed by an increase. A similar correlation was also found for the heat transfer from the tube wall to the flowing liquid; it also indicates that if the magnetic field is high, the heat transfer is proportional to the Hartmann number. Differing results were obtained for cases characterized by $Ha^2/Re \gg 1$ and $Ha^2/Re < 1$ (where Ha and Re represent the Hartmann and Reynolds numbers, respectively). (TTT)

24191 PROPAGATION AND ATTENUATION OF A CYLINDRICAL BLAST WAVE IN MAGNETOGASDYNAMICS. Bhutani, O. P. (Indian Inst. of Tech., Kharagpur). J. Math. Anal. Appl., 13: 565-76(Mar. 1966).

An analysis is presented of a cylindrical blast wave caused by an instantaneous energy release along a straight line of infinite extent in a conductive gas by means of the compatibility conditions (the Rankine-Hugoniot relations) and an energy hypothesis. The discussion assumes that the gas in which the blast wave propagates is at rest and subjected to both polar and axial magnetic fields. It is shown that, irrespective of the strength of the magnetic field, such a blast decays as its radius is indefinitely increased and approaches the effective sound velocity in the undisturbed gas. To determine the radius of the blast wave at any instant and to compute the flow field within it, an explicit expression (for $\gamma = 2$) for the shock velocity is found. (auth)

24192 METHODS FOR THE DETERMINATION OF CURRENTS AND FIELDS IN STEADY TWO-DIMENSIONAL MHD FLOW WITH TENSOR CONDUCTIVITY. Witalis, E. A. (AB Atomenergi, Studsvik, Sweden). J. Nucl. Energy: Pt. C, 8: 129-35(Mar.-Apr. 1966).

Detailed derivations are given of the basic equations and methods available for the analysis of transverse MHD flow when Hall currents are not suppressed. The gas flow is taken to be incompressible and viscous with uniform tensor conductivity and arbitrary magnetic Reynold's

number. The magnetic field is perpendicular to the flow and has variable strength. Analytical solutions can be obtained either in terms of the induced magnetic field or from two types of electric potential. The relevant set of suitable simplifications, restrictive conditions and boundary value considerations for each method is given. (auth)

24193 INCOMPRESSIBLE STEADY FLOW WITH TENSOR CONDUCTIVITY LEAVING A TRANSVERSE MAGNETIC FIELD. **Witalis, E. A. (AB Atomenergi, Studsvik, Sweden). J. Nucl. Energy: Pt. C, 8: 137-43 (Mar.-Apr. 1966). (AE-209).**

The straight channel flow of an inviscid, incompressible fluid with tensor conductivity is considered when the flow leaves a region of constant transverse magnetic field. The channel walls are taken to be insulating, and an eddy current system arises. This is investigated by the method of magnetic field analysis as given by Witalis. The spatial distribution of magnetic field and ohmic power loss, both parallel and transverse to the flow, are given as functions of the Hall parameter with consideration also to the magnetic Reynold's number of the fluid. MHD power generator aspects of this problem and the results are discussed. (auth)

24194 AN EQUATION FOR DEVELOPMENT OF THE DOUBLE DISTRIBUTION FUNCTION OF A SYSTEM OF PARTICLES. **Salmon, J. (Conservatoire National des Arts et Metiers, Paris). J. Phys. (Paris), 26: 753-64 (Dec. 1965). (In French).**

By expressing the triple distribution function in terms of simple and double distribution functions, products on the basis of the BBGKY system of equations, an evolution equation of the double distribution function is obtained, which appears to be easy to handle. Its application to the case of homogeneous gas consisting of neutral molecules leads to the equation of state. The numerical calculations on argon with modified Lennard-Jones potential have allowed us to obtain the variations with temperature of the second and third virial coefficients. The agreement with experiment is satisfactory over a wide range. Lastly, application of evolution equation to the case of an electron's gas immersed in a positive ion sea allows us to find the Debye length. (auth)

24195 ION MOBILITIES IN HELIUM. **Beaty, E. C.; Browne, J. C.; Dalgarno, A. (Queen's Univ. of Belfast). Phys. Rev. Lett., 16: 723-4(Apr. 25, 1966).**

A proposed identification of the fastest ion observed in mobility measurements of ions in helium is presented. The suggested ion is the metastable $^4\Sigma_u^+$ of He_2^+. (B.G.D.)

24196 CONTROL ENGINEERING APPROACH TO MAGNETOHYDRODYNAMIC STABILITY. **Cooper, W. H. B.; Gillespie, A. B.; Aldridge, E. E.; Contos, J. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Inst. Elec. Eng. (London), 113: 517-24(Mar. 1966). (CLM-P-69).**

The well established transfer-function method of determining the stability of lumped-parameter dynamic systems is applied to a study of the stability of an infinitely conducting fluid immersed in a magnetic field. Such a system is both distributed in space and multidimensional, and it is shown how, by the application of a modal energization technique, the whole may be replaced by a number of simpler systems, each subjected to a spatial energization in the fundamental or a higher-order (harmonic) mode, and each amenable to a one-dimensional analytical treatment. Complete stability is obtained only if all the component systems are themselves individually stable. To accommodate the distributed nature of the system the concept of field impedance is introduced, and, to help the electrical engineer to understand and appreciate better the physical significance of the problem, the whole is converted to an equivalent circuit or analog, involving electric transmission lines. A further advantage of this approach is, of course, the wealth of analytical solutions and tabulated transforms which are applicable to the electric network field. Two particular geometrical configurations are then discussed in detail. In the first, a cylindrical fluid is contained by an axially directed magnetic field, and, in the second, a cylindrical fluid is contained by a circumferentially directed magnetic field. These are two geometries which were intensively studied in the controlled thermonuclear fusion field and are usually referred to as the θ pinch and the Z pinch, respectively. (auth)

24197 THERMAL DIFFUSION IN ISOTOPIC GAS MIXTURES AND INTERMOLECULAR FORCES. **Saxena, S. C.; Mathur, B. P. (Univ. of Rajasthan, Jaipur, India). Rev. Mod. Phys., 38: 380-x(Apr. 1966).**

Available thermal diffusion data on He, Ne, Ar, Kr, Xe, H_2, N_2, O_2, CO, CH_4, NH_3, HCl of different workers are discussed. This study revealed the need and nature of the additional measurements, which will be useful and is thus of help in planning new experiments. The problems of temperature assignment and composition dependence of the thermal diffusion factor α_T are examined. The adequacy of the theoretical α_T expression used while interpreting the experimental data are made with the prediction of the rigorous Chapman-Enskog kinetic theory in conjunction with the three spherically symmetric potentials (Lennard-Jones 12–6, modified Buckingham exp-6, and Morse) for nonpolar gases, while a Stockmayer type 12-6-3 potential for polar gases. Reasonably satisfactory agreement is obtained even for polyatomic gases. The extent to which Chapman-Enskog theory in conjunction with central force-field models may be expected to hold for polyatomic gases is investigated. The up-to-date knowledge of the kinetic theory, which takes into consideration inelastic molecular collisions, is reviewed. (auth)

24198 SOME PROPERTIES OF THE SHORT ARC IN CESIUM VAPOR. **Korchevoi, Yu. P.; Semichaevskii, V. D. (Kiev State Univ.). Ukr. Fiz. Zh., 11: 177-82(Feb. 1966). (In Ukrainian).**

The gradual development is discussed of the arc discharge in cesium vapor in a diode with a short distance between electrodes l = 1.9 cm and an incandescent tungsten cathode. The probe procedure is used to determine the distribution between electrodes of the plasma parameters for three successive forms of its existence: (1) with a luminous film on the anode, (2) with a luminous sphere, and (3) with cathode glow. It is shown that the properties of such a charge depend to a great extent on the point of generation of positive ions in the narrow space between the electrodes. (auth)

24199 THE NATURE OF CRITICAL POINTS. **Fisher, Michael E. (Rockefeller Inst., New York). pp 1-159 of Lectures in Theoretical Physics. Vol. VII C. Boulder, Colo., Univ. of Colorado Press, 1965.**

The experimental facts and theories concerning critical points, especially in fluid and magnetic systems, are reviewed. The main emphasis is on the fundamental problems and on recent theoretical developments. (G.O.Y.)

24200 NOTES ON THE RADIAL DISTRIBUTION FUNCTION OF A QUANTUM FLUID. **Feenberg, Eugene (Washington Univ., St. Louis). pp 160-74 of Lectures in Theoretical Physics. Vol. VII C. Boulder, Colo., Univ. of Colorado Press, 1965.**

The description of a uniform quantum fluid by a set of n-particle distribution functions is discussed, and a fluctuation theorem for the ground state is given. The ground states of non-interacting boson and fermion systems are treated as examples. The distribution functions under equilibrium conditions are also discussed. (G.O.Y.)

24201 THE BOSE FLUID. **Lieb, Elliott H. (Yeshiva Univ., New York). pp 175-224 of Lectures in Theoretical Physics. Vol. VII C. Boulder, Colo., Univ. of Colorado Press, 1965.**

The theory of Bose gases is outlined starting with the Bogoliubov theory. (D.C.W.)

24202 SELECTED TOPICS IN MANY-BODY THEORIES. **ter Haar, D. (Magdalen Coll., Oxford). pp 239-68 of Lectures in Theoretical Physics. Vol. VII C. Boulder, Colo., Univ. of Colorado Press, 1965.**

The effects of phonon lifetimes on the nature of phonon

interactions in liquid helium are studied, and Landau's theory of Fermi liquids is extended to dilute solutions of impurities in a Fermi liquid. Macroscopic and microscopic derivations of the Hamiltonian for the interaction of an electron with the polarization field in a crystal are also outlined. (D.C.W.)

24203 TEPLO-I MASSOPERENOS. TOM II. TEPLO-I MASSOPERENOS PRI VZAIMODEISTVII TEL S POTOKAMI ZHIDKOSTEI I GAZOV. (Heat and Mass Transfer. Vol. II. Heat and Mass Transfer in Interactions of Bodies With Liquid and Gas Streams). Lykov, A. V.; Smol'skii, B. M. Minsk, Nayka i Tekhnika, 1965. 454p.

Thirty-eight articles are included. A separate abstract was prepared for one. Articles not abstracted include discussions of effects of physical factors on processes occurring in laminar gas flow, supersonic gas flow around bodies, boundary-layer problems in the presence of physical-chemical transformations on a surface, and turbulent movement of gases for various velocities and boundary conditions in the cases of a bounded layer and of jet flow. (M.J.T.)

For an abstract of the individual paper see: 24204.

24204 HEAT EXCHANGE IN INCOMPRESSIBLE FLUID FLOW IN THE PRESENCE OF MAGNETIC FIELD. Novikov, I. I. (Inst. of Thermal Physics, Academy of Sciences, Siberian SSR). pp 111-19 of Teplo- i Massoperenos. Tom II. Minsk, Nayka i Tekhnika, 1965. (In Russian).

The equations of motion and of heat transfer for the flow of an electrically conducting liquid in the presence of a magnetic field are developed under the assumptions that the liquid is noncompressible and the bounded MHD layer is laminar. Relations are derived for the rate of heat flow and the Nusselt number, for the Prandtl number equal to and different from unity, for the cases of turbulent flow in a weak magnetic field with kinematic viscosity greater than magnetic viscosity, turbulent flow in a rather weak field, and flow of a liquid with large magnetic viscosity in a transverse magnetic field. (M.J.T.)

Geophysics

Refer also to abstracts 23075, 23855, 23870, 24300, and 24507.

24205 (AD-624392) DETERMINATION OF IONOSPHERIC LOSS COEFFICIENTS FROM OBSERVATIONS ON SATELLITE X-RAY FLUXES AND SUDDEN IONOSPHERIC DISTURBANCES. Mitra, Ashesh P. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Oct. 1, 1965. Contract AF19(628)-4014. 32p. (AFCRL-65-77). CFSTI $2.00 cy, $0.50 mn.

Use has been made of recent satellite measurements of the solar-flare x-ray flux and, where available, its spectral distribution for detailed quantitative examination of the accompanying sudden ionospheric disturbances, principally sudden cosmic noise absorption (SCNA). From observed or assumed spectral distributions of the x-ray flux, profiles of ion production rates are obtained for a few specific events. A comparison of these production rates with the observed excess attenuation during the peak of the SCNA leads to an upper limit for the value of the effective dissociative recombination coefficient (α_c) when negative ions are ignored. These limiting values were found to range between 0.0000001 to 0.000001 cc/s. When the effect of negative ions is considered, α_c is reduced to values around $1-4 \times 10^{-8}$ cc/s. An extension of the above method involves the simultaneous use of SCNAs and SPAs at very low frequencies, along with x-ray spectral data. When this is done, it is possible to obtain information on both the dissociative recombination coefficient and negative ions. (TAB)

24206 (AD-624776) A SURVEY OF MAGNETIC STORMS. Vestine, E. H. (RAND Corp., Santa Monica, Calif.). Dec. 1965. 17p. (P-3270(RAND)). CFSTI $1.00 cy, $0.50 mn.

A brief summary of the knowledge of magnetic storms is presented. (D.C.W.)

24207 (AD-625960) THE ENERGETIC CHARGED PARTICLE ENVIRONMENT OF THE EARTH (HITCH-HIKER I DATA ANALYSIS). Final Report, May 15, 1964-August 14, 1965. Paolini, Frank R.; Theodoridis, George C.; Bate, Michael (American Science and Engineering, Inc., Cambridge, Mass.). Sept. 13, 1965. Contract AF19(628)-4207. 150p. (AFCRL-65-692). CFSTI $4.00 cy, $1.00 mn.

The results of the reduction and analysis of data obtained from instrumentation flown on the Air Force Satellite Hitch-hiker I (1963-25B) are presented. The instrumentation included two electrostatic analyzers (one for electrons of 15 to 100 kev, the other for protons of 15 to 100 kev); a scintillation spectrometer (for electrons of 0.7 to 4.0 Mev); a phoswich scintillation spectrometer (for protons of 1.0 to 5.0 Mev and 7.5 to 120 Mev); and a Geiger counter (electrons greater than 4.0 Mev, protons greater than 40.0 Mev). Detailed data on integral energy spectra, pitch angle distributions, and perpendicular unidirectional intensities, as functions of B, L (or lambda, L) and time are given. No substantial intensities of protons of 15 to 100 kev were observed. Electrons of 15 to 100 kev were observed with intensities as great as 2×10^5 cm^2-sec-ster-kev at 40 kev, but the anomalous angular distributions obtained cast doubt on the credibility of these data. Peak inner belt intensities for electrons above 1 Mev were about 5×10^5 electrons/cm^2-sec-ster at L approx. 1.6. (TAB)

24208 (AD-626167) UPPER ATMOSPHERE PHENOMENA ASSOCIATED WITH THE 2+ SOLAR FLARE OF OCTOBER 22, 1963. Environmental Research Papers. Kidd, William C. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Oct. 1965. 31p. (AFCRL-65-762). CFSTI $2.00 cy, $0.50 mn.

The changes triggered by a solar flare in a number of atmospheric phenomena studied at one location. The x-ray induced events such as sudden ionospheric absorption occurring immediately after the flare were of relatively short duration, that is, one to two hours and show the familiar course of events. However, the corpuscular-induced ionospheric events such as auroral absorption and scintillation which follow the flare by approximately a day and a half are of interest in their latitude variation. Some observations, such as 19-Mc/sec radar backscatter and ionosoundings, show no time lag with reference to the commencement of the geomagnetic storm. The riometers show that the absorption phenomena commence first in the north and move in time to the south. The radiostar and scintillation observations show the same motion in time, that is, away from the auroral zone with the 200- to 400-km irregularities which produce scintillations showing a lower latitude boundary during the storm than before commencement. (TAB)

24209 (N-65-33285) INFLUENCE OF THE EARTH'S ROTATION UPON THE INTERACTION OF THE SOLAR WIND WITH THE MAGNETOSPHERE. Hones, Edward W. Jr. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). July 1965. 42p. (NASA-CR-64820). CFSTI $2.00 cy, $0.50 mn.

The results of an experimental and theoretical analysis of the influence of the earth's rotation on the coupling of solar-wind energy into the magnetosphere are presented. Described are experiments, conducted with objects in water, which demonstrate that circulation established by bodies rotating in a viscous fluid may be modified and its velocity enhanced if the fluid is streaming past the bodies. The additional circulation energy is derived from reorientation of the stream flow near the bodies. These demonstrations suggest that the earth's rotation plays a definite role in coupling the solar wind's energy. On the basis of data derived from the electric field configuration in a model of the magnetosphere and from demonstrations of the behavior of a stream of viscous fluid as it flows past rotating bodies, a theory is proposed to account for the energy-coupling mechanism. Included is a discussion of

existing theories which attempt to explain this phenomenon and the feasibility of qualitatively determining the influence of the earth's rotation experimentally with a rotating terrella in the laboratory. (STAR)

24210 (TG-230-T466) PHYSICAL PICTURE OF THE FORMATION OF AN ARTIFICIAL RADIATION BELT BY THE AMERICAN HIGH-ALTITUDE THERMONUCLEAR BURST OF JULY 9, 1962. Gal'perin, Yu. I. Translated for Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md., from Kosm. Issled. Prostranstva, Spec. Issue, 388-93(1965). 10p.

Direct observations by Kosmos-5 and other satellite sources indicate that the final radius of the plasma cloud accompanying the American high-altitude burst of 9 July 1962 did not exceed 600 km. This is less than the final radius for a plasma cloud expanding in a vacuum, which indicates considerable dissipation of energy. Particle ejection beyond the plasma cloud is assumed to be the reason for this discrepancy and three mechanisms are proposed to explain the ejection: (1) diamagnetic ejection of plasma blobs due to instability at the interface between plasma and field; (2) free separation in the magnetosphere of fission fragments neutralized in the beginning stages of cloud expansion, i.e., before the stage of "inertial separation"; (3) free separation in the magnetosphere of fragments neutralized by charge exchange between ions in the plasma cloud and neutral particles in the atmosphere. (auth)

24211 VLF PHASE PERTURBATIONS ASSOCIATED WITH HIGH-ALTITUDE NUCLEAR BURSTS. Haave, C. R.; Zmuda, A. J.; Shaw, B. W. (Johns Hopkins Univ., Silver Spring, Md.). APL Tech. Dig., 2: 14-19(Nov.-Dec. 1962).

The effects of the high-altitude nuclear burst of July 1962 on vlf propagation paths remote from the burst, due to geomagnetic deflection of charged particles into the vlf path, are described. The vlf perturbations noted for the Hawaii (NPM)-to-Howard County, Maryland, Jim Creek, Washington, (NPG)-to-Howard County, and Balboa, Panama, (NBA)-to-Howard County paths are shown. These exemplify the two types of perturbations—those due to particles attached to field lines directly accessible from the burst region and those due to particles geomagnetically trapped and drifting longitudinally from the burst into the vlf path. It is found that the delayed vlf perturbations associated with high-altitude nuclear bursts are correlated in time and magnitude with the temporal energy variations of geomagnetically trapped particles drifting over the path. (M.J.T.)

24212 MIRROR POINT DISTRIBUTIONS IN THE MAGNETOSPHERE. Venkatarangan, P. (National Aeronautical Lab., Bangalore, India). Curr. Sci. (India), 35: 139-40 (Mar. 20, 1966).

The main geomagnetic field is expressed as a spherical harmonic summation and the effect of nondipole terms on the mirror points is investigated. The equations are evaluated numerically to order to obtain values of the colatitude θ_M and the corresponding angle at which the charged particle crosses the equator α_e. The distribution of mirror points with respect to the longitude is shown schematically. (L.B.S.)

24213 INVESTIGATION OF THE OUTER RADIATION BELT AT LOW ALTITUDES. Shavrin, P. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1909-12(Oct. 1965). (In Russian).

Data are reported on the location at low altitudes of the outer radiation belt and the variations of the radiation intensity within it, recorded with scintillation counters on satellites of the Kosmos series and the first and second Soviet satellite vehicles. During 1959 and 1960 the maximum of the outer radiation belt occurred at L-values less than 4.5; the maximum tended to shift from L = 4 to L = 3 with increasing magnetic disturbance. The L-coordinate of the maximum of the outer radiation belt tended to decrease with increasing values of the 3-hour planetary K_p-index. During 1962 and 1963 the maximum of the outer belt occurred at L-values between 4 and 6. Supplementary radiation intensity maxima were detected in the slot between the radiation belts at L-values between 2 and 3. The positions and intensities of these maxima, which were from 5 to 20% as intense as the principal maximum at L > 4, varied considerably. Low-altitude intensity variations in the outer belt were also observed. The high-altitude nuclear explosions in 1962 did not significantly increase the radiation intensity for L > 2.5. (ATD)

24214 FIXED-FREQUENCY OBSERVATIONS OF PLASMA RESONANCES IN THE TOPSIDE IONOSPHERE. Calvert, W.; VanZandt, T. E. (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). J. Geophys. Res., 71: 1799-1813(Apr. 1, 1966).

On the records of the fixed-frequency topside sounder aboard Explorer 20 satellite, plasma resonances are observed at the plasma frequency, the upper hybrid frequency and its second harmonic, and the harmonics of the cyclotron frequency. On the fixed-frequency records, the resonances are excited over a period from 15 seconds up to several minutes long. Each kind of resonance has a characteristic pattern. On all of the resonances except the second harmonic of the upper hybrid resonance, these patterns consist, at least in part, of interference-like fringes, which are modulated in spacing and intensity by the spin of the satellite. The maximum intensity of the fringes occurs when the antenna is either parallel or perpendicular (depending on the kind of resonance) to the earth's magnetic field. These fringe patterns and orientations give some insight into the mechanisms of excitation of the resonance. Patches of thin, slanted lines form a trace on the low-concentration side of the plasma resonance, with a shape similar to the ordinary-mode electromagnetic trace but with time delays an order of magnitude larger. It is suggested that these patches are the echoes of electrostatic waves reflected from the underlying ionosphere. No resonance phenomena are observed at the cutoffs of the extraordinary-mode electromagnetic propagation. However, irregularities in electron concentration sometimes spread the traces near cutoff so that they would look like resonances on swept-frequency records. Conversely, on those occasions when the traces near cutoff are quite smooth, there can be present no irregularities in which the electron concentration differs by more than 10 electrons cm^{-3} ($\lesssim$0.05%) from the ambient. It is shown that the resonances and cutoffs can be used to derive curves of electron concentration along the orbit of the satellite. It is also shown that the gradient of electron concentration can be accurately inferred from the modulation of the plasma resonance or of the extraordinary-mode electromagnetic cutoffs by the frequency spectrum of the transmitted pulse. (auth)

24215 MODEL EQUATORIAL ELECTROJET. Sugiura, Masahisa; Cain, Joseph C. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 71: 1869-77(Apr. 1, 1966).

The cross-sectional profile of the equatorial electrojet is determined for various longitudes along the dip equator using a set of 48 gauss coefficients for the earth's magnetic field. The electrojet profile is found to vary appreciably with longitude due to the asymmetry of the magnetic field. To demonstrate the longitudinal variation of the electrojet the profiles for longitudes 80°E (for India) and 280°E (for Peru) are shown. The maximum current density in the electrojet for the latter longitude is found to be much greater than that for the former longitude. Also the width of the electrojet is greater at 280°E than at 80°E. The magnetic field produced by the electrojet is computed for various longitudes along the dip equator and also for the locations of six magnetic observatories near the dip equator. The theoretically expected field changes are qualitatively in agreement with the observed values for these observatories. The average electron drift velocity in the electrojet is estimated; over Peru this velocity reaches a few km/sec during a sunspot maximum period at the height of the peak of the electrojet. This value is considerably higher than earlier estimates and is well above the critical

electron velocity, i.e., the ion thermal velocity, above which the two-stream instability can occur. (auth)

24216 EQUATORIAL ELECTROJET. Gassmann, G. J.; (Air Force Cambridge Research Labs., Bedford, Mass.); Wagner, R. A. J. Geophys. Res., 71: 1879-90 (Apr. 1, 1966).

During 29 crossings of the geomagnetic dip equator near 80°W longitude in February and July 1964, airborne equipment obtained cross sections of geomagnetic field intensity and ionospheric characteristics. The magnetic anomalies due to the electrojet and the amplitudes of E_{sq} echoes show fair correlation of details and fair-to-good correlation of large scale features. Width and position of the electrojet vary considerably from hour to hour and from day to day. The data suggest that the electrojet during certain days in February was separated into two or more parallel streaks. The magnetic data also show strong electric currents in the ocean. Those appear to be a sector of the "internal part" of the S_q current system, however stronger than anticipated. (auth)

24217 MAGNETIC TOROIDAL RESONANCES AND VIBRATING FIELD LINES. Radoski, Henry Robert (Boston Coll.). J. Geophys. Res., 71: 1891-3(Apr. 1, 1966).

In the heuristic approach to toroidal resonances of the geomagnetic field-magnetosphere system the fundamental period is defined as twice the bounce time along a field line. The validity of this concept is investigated by considering the WKB approximation of the basic toroidal equation. The plasma density is assumed to have a radial dependence of the form $\rho \alpha \gamma^{-m}$ where m varies between 0 and 6. It is found that the approximation is valid only for low and middle latitudes unless m approaches 6, at which value the WKB solution becomes exact. (auth)

24218 18-Mc/s AURORAL ABSORPTION IN MIDDLE LATITUDES. Lichtenstein, Pearl R. (Rensselaer Polytechnic Inst., Troy, N. Y.). J. Geophys. Res., 71: 1899-1910(Apr. 1, 1966).

Auroral absorption was studied in cosmic noise data obtained at Grafton, New York, ($\Phi = 54°$) from 1957 to 1961. Such absorption is found to occur most frequently near the times of the equinoxes and least often in winter. The daily occurrence curve has a double maximum, with peaks near sunset and at 0300 local time. Comparison with similar data obtained at Lake Angelus, Michigan, shows the events to be generally large scale. Some cases of blackout, related to PCA events, and of daytime aurora are described and discussed. A theoretical analysis using accepted recombination rates reproduces the qualitative features of the observed classes of events. The intensity and time variability of the absorption are found to be related to particle penetration depth and electron production rate. (auth)

24219 IONIZATION ENHANCEMENT FROM VAN ALLEN ELECTRONS IN THE SOUTH ATLANTIC MAGNETIC ANOMALY. Zmuda, A. J. (Johns Hopkins Univ., Silver Spring, Md.). J. Geophys. Res., 71: 1911-17(Apr. 1, 1966).

Satellite particle observations have shown that a longitudinal dependence exists for trapped electrons at B-L points extending into the lower atmosphere over the South Atlantic anomaly. The longitudinal variation results from the precipitation and loss of trapped particles drifting through the anomaly and is a regular characteristic of the Van Allen radiation zones. The trapped electrons that collide with atmospheric constituents produce ionization and represent a significant source of local enhancements in the D and lower E regions of the ionosphere. Regions where electron-ion augmentations may be expected are also discussed. (auth)

24220 GEOMAGNETIC ACTIVITY AND SIZE OF MAGNETOSPHERIC CAVITY. Patel, V. L.; Dessler, A. J. (Rice Univ., Houston, Tex.). J. Geophys. Res., 71: 1940-2(Apr. 1, 1966).

Magnetopause locations, which were determined by the Explorer 12 SpL charged-particle detector and the Imp 1 plasma experiment, were used to study the relation between solar wind parameters and geomagnetic activity. No strong correlation was evident between the size of the magnetosphere, as determined from magnetopause crossings, and geomagnetic activity indexes. It is argued that this finding supports the hypothesis that time variations in solar wind parameters are the principal agent responsible for the geomagnetic activity characterized by Ap or Kp indexes. (L.B.S.)

24221 GEOMAGNETIC AND SOLAR DATA. Lincoln, J. Virginia (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). J. Geophys. Res., 71: 1943 (Apr. 1, 1966).

Geomagnetic and solar data - K_p, C_i, C_p, A_p, K_{Fr}, R_z- are tabulated for November 1965. (L.B.S.)

24222 NIGHT-TIME ELECTRON TEMPERATURES IN THE UPPER F REGION. Nathan, K. V. S. K.; Seaton, M. J. (London Univ.). Nature, 209: 701-2(Feb. 12, 1966).

The suggestion by Willmore (Proc. Roy. Soc., A, 281, 526(1964)) that an energy input $Q/n_e = 1.5 \times 10^{-5}$ ev sec^{-1} is required at 650 km to maintain the temperature difference and that bombardment by electrons of kilovolt energies might provide a suitable source is shown to be consistent with an upper limit on the precipitated flux of fast electrons set by optical observations. (B.G.D.)

24223 TIME VARIATIONS OF GEOMAGNETIC H AND D AT DISTURBED STATIONS. Eleman, Folke (Goddard Space Flight Center, Greenbelt, Md.). Nature, 209: 1120-1(Mar. 12, 1966).

The cylindrical co-ordinate system, defined by the components H, D, and Z, used to describe the geomagnetic field bring some noteworthy consequences when going from the field to its time gradients. These effects are sometimes overlooked in magnetic cartography and research work. The effect of a crust anomaly on the field was measured at a certain station at a certain time. The need for considering the influence of local anomaly on the geomagnetic field at magnetic observatories is stressed. (C.H.)

24224 HYDROMAGNETIC FLOW AROUND THE MAGNETOSPHERE. Spreiter, John R.; Summers, Audrey L.; Alksne, Alberta Y. (Ames Research Center, Moffett Field, Calif.). Planet. Space Sci., 14: 223-53(Mar. 1966).

A magnetohydrodynamic model for the interaction of the solar wind and the geomagnetic field is described. The degree to which the governing equations may be approximated by the simpler equations of the classical Chapman-Ferraro combined with gasdynamics is examined, and numerical results for a number of representative cases are presented. In the hydromagnetic model, the magnetosphere boundary and distant tail are represented by tangential and contact discontinuities; and the bow wave is represented by a fast hydromagnetic shock wave. The connectivity of interplanetary and geomagnetic fields, and the asymptotic directions of the wake and shock waves at great distances from the Earth are discussed in terms of properties of these discontinuities. Detailed numerical results for the location of the bow wave, and the density, velocity, and temperature of the flow in the region between the bow wave and the magnetosphere are presented for Mach numbers 5, 8, and 12 for $\gamma = 5/3$ and 2. The calculated position of the bow wave is shown to be in good accordance with that observed in shadowgraphs of supersonic flow past a model magnetosphere in the Ames Supersonic Free-Flight Wind Tunnel. Results are also presented that illustrate the distortion of the interplanetary magnetic field in the region between the bow and the magnetosphere for cases in which the magnetic field in the incident stream is inclined at 45 and 90° to the free-stream direction. (auth)

24225 ON THE EFFECT OF HEAVY IONS ON LF PROPAGATION, WITH SPECIAL REFERENCE TO THE NUCLEAR ENVIRONMENT (DIGEST). Johler, J. Ralph; Berry, Leslie A. (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). Radio Sci., 1: 303-7 (Mar. 1966).

An ionized plasma is induced in the upper atmosphere as a result of radioactive debris deposited by a nuclear explosion. A discussion is presented on the increased attenuation of low-frequency radiowaves in the vicinity of this nuclear event. Transmission and reflective coefficients in such a highly ionized region are investigated. (B.G.D.)

24226 THE EFFECTS OF HIGH-ALTITUDE EXPLOSIONS. Hess, Wilmot N. (Goddard Space Flight Center, Greenbelt, Md.). Select. TRW Space Technol. Lab. Lect. Ser., 2: 22-34(1965).

Seven artificial radiation belts have been made by the high-altitude explosion of nuclear bombs since 1958. These radiation belts consist of large populations of charged particles trapped by the earth's magnetic field for long periods of time. A discussion is presented on neutrons as the source of these radiation belts. The motion of charged particles in a magnetic field is discussed in order to explain how an artificial belt of particles surrounding the earth is made from a point source explosion. Satellite data on project Starfish on July 9, 1962 is presented. The effects of artificial radiation belts to radiation sensitive components aboard spacecraft and on natural radiation belts are discussed. The changes of the electron energy spectrum with increasing distance from earth and electron decay in artificial radiation belts are considered. (B.G.D.)

24227 MECHANISM OF PENETRATION OF SOLAR PLASMA INTO THE GEOMAGNETIC FIELD. PART I. Tu, Heng (Peking Univ.). Ti Ch'iu Wu Li Hsueh Pao, 13: 201-10(1964).

The mechanism for tracing the process of penetration of the solar wind into the magnetosphere was studied. From Singer's explanation of the main phase ring current as being due to charged particles trapped in the geomagnetic field, the origin of these particles has become one of the important problems of main phase theory. It was assumed that if there is no other force than the magnetic field, all charged particles approaching the magnetosphere will be reflected back into space, even around the neutral points on the boundary. It was stated that because of the differential reflection of electrons and protons, a polarized electric field will eventually be established around the neutral point in a westward direction. Under the action of this electric field, charged particles with small pitch angles will pass through the neutral point. It was concluded that electrons will be captured more easily and with larger capture probability than protons. With a suitable choice of the parameters of the solar wind and the capture probability, the results may explain the theoretical investigations of Parker and others fairly well. (CFSTI)

24228 LONGITUDINAL ASYMMETRY OF THE MAIN PHASE OF A GEOMAGNETIC STORM. Tu, Heng (Peking Univ.). Ti Ch'iu Wu Li Hsueh Pao, 13: 211-15(1964).

Study of the mechanism of drift motion of a polarized electric field has shown that the electrons of the solar wind may penetrate into the magnetosphere through the neutral point. The electrons trapped in the geomagnetic field will drift eastward, carrying a westward electric current. It was found that before these electrons drift in closed circuit around the earth, the distribution of electrons and, consequently, the current and the magnetic field recorded at the earth's surface in the equatorial region will be asymmetrical with respect to local time. Variations in the magnetic field were calculated as a function of the storm time Tst recorded at observatories located at 00^h, 06^h, 12^h, and 18^h local time. The assumption was made that the period of electron drift around the earth was two days. It was concluded that the results obtained coincided well with the statistical curves obtained from the long series of data from Zo-Se and Hung-chia-yu Observatories. (CFSTI)

Gravitation, Quantum Mechanics, and Relativity Theory

Refer also to abstracts 24071, 24159, 24160, and 24162.

24229 (UCRL-12049-T) EVALUATION OF FEYNMAN'S FUNCTIONAL INTEGRALS. Zimmerman, Robert L. (Lawrence Radiation Lab., Univ. of California, Livermore). Sept. 11, 1964. Contract W-7405-eng-48. 29p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Several relations for Feynman's functional integrals are derived. From these relations two different schemes are constructed for approximating Feynman's functional integral. The methods of approximation are expected to converge sufficiently rapid in many cases so that only the lowest orders of the approximation are required to give reliable answers. (auth)

24230 (UCRL-12101) NUMERICAL SOLUTIONS OF THE SCHROEDINGER EQUATION WITH THE COMPLETE SCREENED COULOMB POTENTIAL. Rouse, Carl A. (Lawrence Radiation Lab., Univ. of California, Livermore). Apr. 5, 1965. Contract W-7405-eng-48. 26p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The complete screened Coulomb potential (CSCP) for a Debye-Hückel ion atmosphere is given by $V(r) = \{V(r) = -Ze^2(1/r - 1/d + a),\ 0 \le r \le a$ and $V_0(r) = -Ze^2(d/d + a)\exp[(a - r)/d]/r,\ r \ge a\}$, where d is the screening length and a is the minimum radius of the ion atmosphere. Some numerical solutions of the Schroedinger equation have been obtained with the CSCP and compared with analytical and numerical solutions with the Coulomb potential. In s-state solutions, it is shown that when a = d = average position of the electron in the Coulomb potential solution, the CSCP yields values of $(\rho R)^2$ reduced by e below the Coulomb values between $a \le r \le d$, with eigenvalues increased by e, approximately. A finite electronic partition function is derived that depends on the relative normalization of the CSCP wave functions. Although no explicit maximum bound quantum state is indicated, the normalization integrals for the bound states decrease as the screening length $d \to 0$. (auth)

24231 (UCRL-16808) INFRARED DIVERGENCES IN QUANTUM ELECTRODYNAMICS [Thesis]. Chung, Victor (Lawrence Radiation Lab., Univ. of California, Berkeley). Mar. 15, 1966. Contract W-7405-eng-48. 58p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The infrared divergences of quantum electrodynamics are eliminated to all orders of perturbation theory in the matrix elements by an appropriate choice of initial and final soft photon states. The coherent state formalism of Glauber is used to parameterize these states. It is shown that the condition for the cancellation of the divergences requires that these states belong to representations of the canonical commutation rules which are unitarily inequivalent to the usual Fock representation. A comparison to lowest order is made between this treatment and the conventional treatment whereby the divergences are cancelled in the total cross section. (auth)

24232 TWO DIFFERENT PHYSICAL INTERPRETATIONS POSSIBLE FOR THE DIRAC ELECTRON THEORY. Hanus, Wanda (Nicholas Copernicus Univ., Torun, Poland). Acta Phys. Pol., 29: 245-7(Feb. 1966).

The problem of extending to the Foldy-Wouthuysen representation the usual statistical interpretation (in terms of the probability and probability current densities fulfilling the continuity equation) is considered. Two alternative ways of constructing the generalized continuity equation are shown, each formally admissible in consequence of the fact that new operators (of the mean position and "mean" spin) have appeared in a natural way in the FW-representation, simultaneously with the transformed traditional Dirac operators. (L.B.S.)

24233 ON THE VACUUM IN GENERALLY COVARIANT QUANTUM THEORY. Laurent, B. E. (NORDITA, Copenhagen. Univ. of Stockholm). Ark. Fys., 28: 297-302(1965).

An attempt is made to combine general relativity and quantum theory. Consideration is given to the ideas which led Einstein to the gravitational field equations. Relativity and superposition are used as the main principles, and the vacuum state is discussed. (J.F.P.)

24234 ON THE MOTION OF SPIN-1/2 PARTICLES. Sniatycki, J. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 14: 37-9(1966).

An analog of Ehrenfest's theorem is proved for relativistic motion of spin -½ particles in a homogeneous electromagnetic field, on the basis of an abstract formulation of quantum mechanics due to Tulczjen. (L.B.S.)

24235 APPROACH TO EQUILIBRIUM IN AN EXPLICIT QUANTUM MODEL. Favre, Christian; Marchand, Jean-Paul (Univ., Geneva). Helv. Phys. Acta, 39: 5-20(1966).

A quantum mechanical model is introduced which admits true equilibria (no Poincaré cycles) but avoids calculation in infinite product spaces. The existence and uniqueness question of equilibria is solved in various examples and the approach to equilibrium discussed geometrically in the Liouville space of the physical states. (auth)

24236 SOME REMARKS CONCERNING THE MIRROR REFLECTION SYMMETRY IN THE QUANTUM MECHANICAL ANGULAR MOMENTUM THEORY. Jucys, A.; Savukynas, A.; Bandzaitis, A. (Kapsukas State Univ., Vilnius, USSR. Inst. of Physics and Mathematics, Academy of Sciences, Lithuanian SSR). Lietuvos Fiz. Rinkinys, Lietuvos TSR Mokslu Akad., Lietuvos TSR Aukstosios Mokyklos, 5: 171-84(1965). (In Russian).

The reflection of the coordinate system as well as of the space in the plane of undefined components of the angular momentum is considered. It is concluded that when in the normal (right-hand) coordinate system the angular momentum quantum number j is used, in the reflected (left-hand) coordinate system the quantum number $\bar{j} = -j-1$ must be used. The simultaneous reflection of coordinate system and space is equivalent to the time reversal, in the case of proper functions of the angular momentum operator, and to the transformation of standard irreducible tensorial set to the contra-standard one, in the more general case. Further, it is concluded that in the case of Wigner coefficients as well as of the transformation matrices of coupled angular momentum operator proper functions the space reflection is of no use. The reflection of the coordinate system, however, is very useful. (auth)

24237 REPRESENTATION OF PERMUTATION OPERATORS IN QUANTUM MECHANICS. Seagraves, Paul (Univ. of British Columbia, Vancouver, Can.). Nucl. Phys., 80: 674-80(1966).

It is shown how representations for permutation operators may be constructed for the case of two particles of given angular momentum using operators defined in angular momentum space. The calculations are performed in detail for spin ½, 1, ³/₂ and 2. A method for construction of projection operators in angular momentum space is also included and worked out in detail for the addition of two angular momenta j = ½. (auth)

24238 REDUCTION OF THE ELECTROMAGNETIC VECTOR POTENTIAL TO THE IRREDUCIBLE REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP AND MANIFESTLY COVARIANT QUANTIZATION WITH A POSITIVE-DEFINITE METRIC FOR THE HILBERT SPACE. Moses, H. E. (Massachusetts Inst. of Tech., Lexington). Nuovo Cimento (10), 42: 757-81(Apr. 21, 1966).

The vector potential is expanded into modes, the amplitudes of which are wave functions for massless particles of spin 0 and 1 in Wigner's classification of particles according to the irreducible representations of the inhomogeneous Lorentz group. It is shown that only the spin-1 wave functions contribute to the electromagnetic fields and that they represent circularly polarized electromagnetic waves. On replacing the wave functions by operators, a manifestly covariant quantization of the vector potential acting on a Hilbert space is obtained in which the norm of the Hilbert space and the energy are positive-definite. Unlike the treatments of Fermi and Bleuler and Gupta where the Lorentz condition is required to be satisfied in a subspace of the Hilbert space in order to obtain positive-definite energies and norms, the Lorentz condition is satisfied identically over the entire Hilbert space. Indeed, the quantization procedure resembles that used for the Dirac electron field and has no more difficulties. It is also shown that the new method of quantization does not change in any way the Feynman-Dyson-Wick calculations for the matrix elements of the scattering operator, except that the photon wave functions are now explicit instead of implicit as in earlier treatments. (auth)

24239 $SL_{3,R}$ SYMMETRY IN THE QUANTUM THEORY OF GENERAL RELATIVITY. Rosen, G. (Drexel Inst. of Tech., Philadelphia). Nuovo Cimento (10), 42: 797-803 (Apr. 21, 1966).

The Dirac hamiltonian theory for general relativity is considered with a selected set of dynamical variables as the basic Hermitian field operators in the quantum theory. The 3 spacelike subsidiary conditions are not evoked to eliminate gaugelike degrees of freedom but rather to restrict admissible (co-ordinate-independent) state functionals. Approximate solutions of the timelike subsidiary condition $H_L\Psi = 0$ are obtained for strong quantum-gravitational fields by regarding the momentum terms as prepotent, and since the latter terms exhibit $SL_{3,R}$ invariance, sets of admissible physical states associated with strong quantum gravitational fields are expected to exhibit approximate symmetry with respect to unitary $SL_{3,R}$ transformations. Explicit analysis shows that a certain infinite-dimensional set of approximate one-particle physical states does indeed constitute a basis for a unitary representation of $SL_{3,R}$. (auth)

24240 ALGEBRAIC APPROACH TO QUANTUM MECHANICS. Montvay, I. (Roland Eoetvoes Univ., Budapest). Nuovo Cimento (10), 42: 822-34(Apr. 21, 1966).

A new mathematical frame for quantum mechanics is proposed. Investigating the connection of this frame to the usual one it turns out that this approach corresponds to Haag-Kastler's idea about the algebraic approach to quantum field theory. The most important properties of algebraic quantum mechanics are treated, such as the questions of measurements in infinitely distant regions and at infinitely high momenta. The equations of motion in different pictures are given as differential or integrodifferential equations in ordinary function spaces. (auth)

24241 FLAT THEORY OF GRAVITATION. Capella, A. (CERN, Geneva). Nuovo Cimento (10), 42B: 321-31 (Apr. 11, 1966).

A Lorentz-covariant theory of gravitation is constructed with linear field equations, which accounts for all the observational facts, i.e., the three tests of general relativity, with only one adjustable parameter apart from the gravitational coupling constant. The equations of motion of the theory arise both from a variational principle and from the conservation law of the total energy-momentum tensor of the system. The conservation law of mass is also satisfied. (auth)

24242 THEORETICAL ASPECTS OF THE SPACE RELATIVITY-GYROSCOPE EXPERIMENT. Schiff, L. I. (Stanford Univ., Calif.). Select. TRW Space Technol. Lab. Lect. Ser., 2: 47-50(1965).

Experimental verification of general relativity theory is discussed with respect to three predictions made by Einstein in his original paper which lie within the limits of careful observation. These predictions were the gravitational shift to longer wavelengths (red shift) of light going from a stronger to a weaker gravitational field, the deflection of starlight that passes through the strong gravitational field close to the surface of the sun, and the slow rotation of the major axis, or precession of the perihelion, of the elliptic orbit of an inner planet, Mercury in particular. An understanding on how these three predictions bear on the structure of general relativity is discussed using an experiment consisting of moving a torque-free spherical gyroscope through the gravitational field of the earth and observing the spin precession of its spin axis. (B.G.D.)

24243 EQUATIONS OF MOTION OF SINGULARITIES. Peletminskii, S. V.; Petrov, E. G.; Yatsenko, A. A. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukr. Fiz. Zh., 11: 124-32(Feb. 1966). (In Ukrainian).

The structure of the singularities of a gravitational field in the presence of an external gravitational field is studied. Equations of motion of the singularities are obtained as conditions of the solvability of the field equations. An extended dynamic Lorentz principle, necessary for finding the equations of motion of singularities in nonlinear field theory, is derived as the condition of solvability of the equations of a weak gravitational field. (auth)

24244 GENERAL RELATIVITY AND MACH'S PRINCIPLE. Hoenl, H.; Dehnen, H. (Univ., Freiburg i. B.). Z. Phys., 191: 313-28(1966). (In German).

From the observation field, the concept of the gravitational force and the force of inertia was introduced into the framework of the Einstein gravitation theory in a general covalent manner and on this basis a general relativistic dynamics was developed. An expression was given for the energy-momentum density of the gravitation field, whereupon the gravitational force and the force of inertia have their origin both in the energy momentum of matter and also in the gravitational field. A rigid exposition of the Mach principle was then given from this viewpoint. (tr-auth)

24245 EINSTEIN'S UNIFIED FIELD THEORY. Tonnelat, M. A. New York, Gordon and Breach Science Publishers, 1966. 195p.

Translated from La Theorie du Champ Unifie d'Einstein et Quelques-uns de Ses Developpements by Richard Akerib.

A synthesis and evaluation is given for Einstein's unified field theory. An exposition of the principles of the theory and analysis of the nature of the geometrical synthesis of an affine connection and a fundamental tensor of rank two which satisfies the field equations derived from a variational principle are presented. The explicit solution of these equations relating the affine connection to the fundamental tensor is also given. (J.F.P.)

24246 TEORIYA MOMENTA KOLICHESTVA DVIZHENIYA V KVANTOVOI MEKHANIKE. (Theory of Angular Momentum in Quantum Mechanics). Jucys, A.; Bandzaitis, A. Publication No. 6 of Lietuvos TSR Mokslu Akademijos Fizikos Ir Matematikos Institutas. Vilnius, USSR, Izdatel'stvo Mintis, 1965. 464p.

Properties of the angular momentum operator and its eigenfunctions are presented. The theory of mixing of two angular momenta is discussed, and Clebsch-Gordan and Wigner coefficients are considered. The invariants relative to the rotation of 3-space, the so-called 3nj-coefficients, their symmetry properties, and their graphical representation are studied. Graphical methods of calculation, based on the Clebsch-Gordan coefficients and transformation of matrices, are described. Numerical tables for the Wigner and 6j-coefficients and algebraic formulas for the Wigner, 6j-, and 9j-coefficients are included. (M.J.T.)

24247 REPRESENTATIONS OF THE LORENTZ GROUP IN QUATERNIONIC QUANTUM MECHANICS. Emch, Gerard (Univ., Geneva). pp 1-36 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

Quaternionic quantum mechanics is developed introducing group considerations at the very start. The consequences of introducing special relativity are investigated. Some remarks on a possible link between quaternionic quantum mechanics and isospin are also presented. (G.O.Y.)

24248 SOME REMARKS ON THE PRODUCT OF IRREDUCIBLE REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP. Moussa, P.; Stora, R. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). pp 37-69 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ of Colorado Press, 1965.

The main features of induced representations are summarized using as an application the irreducible representations of the inhomogeneous Lorentz group. A number of unitarily equivalent representations is presented, and the reduction of the product of two irreducible "physically relevant" representations is discussed. (G.O.Y.)

24249 ON THE REPRESENTATION OF FINITE LORENTZ TRANSFORMATIONS. Stroem, Staffan (Chalmers Univ. of Tech., Goteborg). pp 70-8 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

A formalism for the representation of finite Lorentz transformations is outlined in which the matrix elements of the transformations are determined by integration of the infinitesimal relations. (D.C.W.)

24250 ON A CLASS OF EXPLICIT REPRESENTATIONS OF THE HOMOGENEOUS LORENTZ GROUP. Kihlberg, Arne (Chalmers Univ. of Tech., Goteborg). pp 79-86 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

A class of explicit, irreducible, unitary representations of the homogeneous Lorentz group is given. It is explicit in the sense that the Hilbert space is a certain function space over a carrier space. The four-dimensional space of restricted six-vector $(e,h \mid e\cdot h = 0,\ e^2 = h^2)$ is chosen as the carrier space. The class is complete in the sense that any irreducible, unitary representation is unitarily equivalent to a representation in the class. (auth)

24251 ON THE PRIMITIVE CHARACTERS OF THE POINCARE GROUP. Joos, H. (Deutsche Elektronen Synchrotron DESY, Hamburg); Schrader, R. pp 87-106 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

The characters of the irreducible unitary representations of the Poincaré group are studied. The application of the primitive characters in relativistic quantum mechanics is also considered. (D.C.W.)

24252 LORENTZ INVARIANCE AND BREAKING OF LORENTZ INVARIANCE IN QUANTUM THEORY. Haag, R. (Univ. of Illinois, Urbana). pp 107-16 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

A formulation of the logical structure of quantum theory that emphasizes the algebraic side and avoids the use of a Hilbert space is outlined. The physical interpretation and Lorentz invariance of the algebraic theory are briefly discussed. (D.C.W.)

24253 THE GROUP OF AUTOMORPHISMS OF THE POINCARE GROUP. Michel, Louis (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). pp 117-20 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

It is shown that every automorphism of the Poincaré group is a continuous automorphism. (G.O.Y.)

24254 RELATIVISTIC PARTICLE CORRELATIONS. Dreitlein, Joseph (Washington Univ., St. Louis). pp 225-43 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

A relativistic description of states and their transformation properties is given, and the coupling coefficients completely reducing the direct product representation of the Poincaré group are derived for particles of mass $m \geq 0$. The various coupling schemes are then represented, and recoupling coefficients are given. In particular, the electromagnetic multipoles are described in the relativistic scheme. Two-particle correlations are then described in detail, and a general description of the three-body correlation is given. Special consideration is extended to beta-decay correlations. It is shown that the application of the ideas of the Poincaré group render possible a simple and complete analysis of the consequences of the V-A local emission theory for arbitrary spin (up to a dynamic indeterminancy of the form factors). (G.O.Y.)

24255 COVARIANT SPINOR FORMULATION OF RELATIVISTIC WAVE EQUATIONS UNDER THE HOMOGENEOUS LORENTZ GROUP. Parke, William C.; Jehle, Herbert (George Washington Univ., Washington, D. C.). pp 297-386 of Lectures in Theoretical Physics. Vol. VII A. Boulder, Colo., Univ. of Colorado Press, 1965.

A covariant spinor formulation of relativistic wave equa-

tions under the homogeneous Lorentz group is presented. (D.C.W.)

24256 QUANTUM ELECTRODYNAMICS. PROCEEDINGS OF THE IV. INTERNATIONALE UNIVERSITAETSWOCHEN FUER KERNPHYSIK 1965 DER KARL-FRANZENS UNIVERSITAET, GRAZ, AT SCHLADMING (STEIERMARK, AUSTRIA) 25th FEBRUARY–10th MARCH 1965. Urban, Paul (ed.). Acta Phys. Austr., Suppl. II, 1-245(1965). (CONF-650218).

Separate abstracts are prepared for 11 of the 13 papers presented. One paper was previously included in NSA as 19: 37528. One paper was in summary form and was not abstracted for NSA. (B.G.D.)

For abstracts of individual papers see: 23579, 24101, 24257–24264, and 24593.

24257 HIGH-ENERGY QUANTUM ELECTRODYNAMICS. [PART] I. Mitter, H. (Max Plank Institut fuer Physik und Astrophysik, Munich). Acta Phys. Austr., Suppl. II, 22-51 (1965).

A study of the formal structure of the quantized field theory is presented. The expectation values of products of field operators (Green's functions), which are the quantum analog to classical field functions, and Green's functions as response functions to small external perturbations are discussed. (B.G.D.)

24258 QUANTUM ELECTRODYNAMICS WITH FUNCTIONAL CALCULUS. Wess, J. (Univ., Vienna). Acta Phys. Austr., Suppl. II, 52-69(1965).

Three lectures are presented on functional methods and how these methods can be applied to quantum electrodynamics. Derivations are presented in detail. Schwinger's paradoxon, which arises from the fact that the product of two field operators taken at the same space-time point is not a too well defined object, is discussed. Operator solutions of the field equations and the commutation relations are also included. (B.G.D.)

24259 NON-LOCAL QUANTUM ELECTRODYNAMICS. Levy, M. (Univ., Paris). Acta Phys. Austr., Suppl. II, 79-90(1965).

Gauge invariance and the photon mass and the convergence of S-matrix elements in a nonlocal theory are discussed through a nonlocal treatment of quantum electrodynamics. (B.G.D.)

24260 THEORETICAL AND EXPERIMENTAL STATUS OF QUANTUM ELECTRODYNAMICS. Bjoerken, J. D. Acta Phys. Austr., Suppl. II, 91-108(1965).

The testing of the existing theory of quantum electrodynamics against experiments is discussed. The experiments presented are tests of the basic symmetry properties, tests of the dynamics at the large distance limit, tests at small distance limit, and tests for new couplings. (B.G.D.)

24261 HIGH-ENERGY QUANTUM ELECTRODYNAMICS. [PART] II. Johnson, K. Acta Phys. Austr., Suppl. II, 109-32(1965).

A survey of recent efforts to try to understand electrodynamics as a normal Hamiltonian theory is presented. The basic idea behind these efforts is that two domains of approximation to the theory might exist. The usual domain which is the ordinary renormalized perturbation theory yields the empirical successes. This is to be regarded as an approximation scheme valid in the neighborhood of the physical mass shells of the particles which occur in the theory, photons and electrons. For all quantities where the contribution from virtual particle states far from this mass shell is small, the method should work. However, for those quantities which receive large contributions from such states the method fails. It is this failure which leads to the efforts in trying to understand electrodynamics. (B.G.D.)

24262 REVIEW OF CONSISTENCY PROBLEMS IN QUANTUM ELECTRODYNAMICS. Kaellen, Gunnar (Univ. of Lund, Sweden). Acta Phys. Austr., Suppl. II, 133-61 (1965).

A review is presented of recent developments in quantum electrodynamics to see to what extent the older methods can be simplified and made more transparent with the use of recent techniques, thus giving a more consistent view of the field. The formulation of field theories in general and quantum electrodynamics in particular in terms of spectral representations, especially for the two point function of the theory is discussed. (B.G.D.)

24263 THEORIES WITH GAUGE GROUPS. Zumino, Bruno (New York Univ., New York). Acta Phys. Austr., Suppl. II, 212-33(1965).

A discussion is presented of the electro-dynamic formalism to other gauge fields. This point of view has been applied to the group of isospin transformations of a nucleon field. The theory of Yang and Mills is described after a brief review of electro-dynamics. Theories which had their growth as an analogy to electrodynamics are stressed in the formalism, as well as the differences, which arise mainly from nonabelian nature of the isospin group, as contrasted with the abelian nature of the group of ordinary phase transformations. (B.G.D.)

24264 ZERO MASS LIMIT OF A CHARGED PARTICLE IN QUANTUM ELECTRODYNAMICS. Nauenberg, M. (Stanford Univ., Calif.). Acta Phys. Austr., Suppl. II, 234-8(1965).

A discussion on the renormalized perturbation theory in quantum electrodynamics in the limit $m \to 0$ is presented. Since m characterizes the energy scale, information can be obtained on the high energy limit of the theory. The question of whether the theory exists for zero mass charged particles is also included. (B.G.D.)

Low Temperature Physics

Refer also to abstracts 23253, 23421, and 23745.

24265 (N-65-15147) FLUX PENETRATION IN THIN-WALLED SUPERCONDUCTING CYLINDERS. Bourke, Roger D. (Stanford Univ., Calif.). Sept. 1964. 16p. (NASA-CR-60179; SUDAER-206). CFSTI $1.00 cy, $0.50 mn.

Flux penetration into thin-walled superconducting cylinders subjected to a uniform longitudinal field is investigated. A review of past work on the subject is given, including predictions that penetration will occur at fields considerably less than critical. A detailed analysis of the field distribution is made for the geometry of interest, and an attempt is made to observe surface breakdown for cylinders of various wall thicknesses. A method for generating continuous magnetization curves and therefore observing the onset of flux penetration is described. Contrary to some past thoughts on the subject, the onset of penetration is shown to occur at values of the surface field near critical. Finally, these results are discussed in relation to recent work on the cryogenic gyro. (STAR)

24266 (ORNL-P-1221) ON THE TEMPERATURE DEPENDENCE OF THE GINZBURG-LANDAU PARAMETER. Sekula, S. T.; Kernohan, R. H. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 7p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A study of the variation of the strength of the temperature dependence of the Ginzburg-Landau parameter with the degree of coupling in superconductors is summarized. (D.C.W.)

24267 SUPERCONDUCTING PROPERTIES OF IMPURE TANTALUM. Sulkowski, C.; Mazur, J. (Inst. of Physics, Wroclaw). Acta Phys. Pol., 29: 107-17(Feb. 1966).

The variation of the superconducting properties of tantalum with impurity concentration was investigated. The measure of purity was determined from the ratio $R_{300°K}/R_{4.2°K}$, which varied from 8 to 66. It was found that the transition temperature, the critical current, and especially

the critical magnetic field depend on impurity concentration. The possibility of the transition of the most impure tantalum into the second kind of superconductors was pointed out. (auth)

24268 STABILIZATION OF Nb_3Sn SUPERCONDUCTING SOLENOIDS IN SUPERFLUID He. Sampson, W. B.; Strongin, M.; Paskin, Arthur; Thompson, G. M. (Brookhaven National Lab., Upton, N. Y.). Appl. Phys. Lett., 8: 191-2(Apr. 15, 1966).

It was found during an investigation of the effect of temperature changes on the flux jumping behavior of superconducting solenoids that the performance of Nb_3Sn magnets can be considerably improved by operating them at temperatures below 2.18°K, the superfluid transition temperature of liquid helium. (L.B.S.)

24269 MAGNETOMETER WITH FILM HALL PROBE, WORKING AT LIQUID HELIUM TEMPERATURE. Odenov, S. V.; Udzulashvili, G. A.; Khvedelidze, V. E.; Chigvinadze, D. G.; Shukhman, V. A. (Academy of Sciences, Georgian SSR). Cryogenics, 6: 46-7(Feb. 1966).

A thin film Hall emf probe of mercury selenide for measuring magnetic fields in thin film superconducting circuits is described. A current calibration of the probe was carried out to judge the possibility of the probe as a current measuring device. (B.G.D.)

24270 A SIMPLE ^{3}He CRYOSTAT AND THE SPECIFIC HEATS OF NYLON AND AN EPOXY RESIN BELOW 4.2 DEG K. Brewer, D. F.; Edwards, D. O.; Howe, D. R.; Whall, T. E. (Univ. of Sussex, Brighton, Eng.). Cryogenics, 6: 49-51(Feb. 1966).

A simple ^{3}He cryostat is described which can be used for constant-temperature experiments or, after all of the liquid ^{3}He has been evaporated, for specific heat measurements, in the range 0.3 to 4.2°K or above. The apparatus is demonstrated by measurements of the heat capacity of nylon and araldite. (B.G.D.)

24271 A 71-kOe ELECTROMAGNET FOR MEASUREMENTS AT 4.2 DEG K. Lange, F. (Deutsche Akademie der Wissenschaften, Dresden). Cryogenics, 6: 51-2 (Feb. 1966).

Modifications of a solenoid cooled with liquid nitrogen, which was described earlier (Exp. Techn. Phys., 13: 61 (1965)), by the insertion of additional pole pieces made of an iron–30% cobalt alloy are presented. (B.G.D.)

24272 ONSET OF INSTABILITY IN THE MAGNETIC BEHAVIOR OF SUPERCONDUCTING Nb_3Sn HOLLOW CYLINDERS. Lange, F. (Deutsche Akademie der Wissenschaften, Dresden). Cryogenics, 6: 56(Feb. 1966).

An examination of previous results in the flux jump behavior in Nb_3Sn hollow cylinders is presented. The boundary temperature below which flux jumps take place, but above this temperature under otherwise equal conditions, where they could not be observed, is considered (B.G.D.)

24273 SUPERCONDUCTING-NORMAL TRANSITION IN HARD SUPERCONDUCTOR. Ihara, Seijiro; Hidaka, Kazuhiko; Miyata, Hiroshi; Shinada, Koichiro (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 29: 847-62(1965).

Thermal propagation of a normal-superconducting boundary along a wire is discussed. The moving boundary velocity is used to give the expression for the performance of the circuit with a superconductor. Experimental data for the wire of Nb–25% Zr are presented as an example. Current induced normal transition in the wire of Nb–25 % Zr is described also. The resistance restoration curve is obtained experimentally and assumed to be linear with time scale. The constant rate of resistance restoration is used in the circuit equations and the solutions are simplified in order to give the estimates of the currents and voltages during the normal transition. (auth)

24274 DETERMINATION OF THE CRITICAL TEMPERATURE OF A SUPERCONDUCTOR WITH PARAMAGNETIC IMPURITY IN THE TWO-BAND MODEL. Moskalenko, V. A. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 165: 313-15(Nov. 11, 1965). (In Russian).

An investigation was made on the influence of the paramagnetic impurity on the critical temperature of a superconductor. It was found that the cases of nonmagnetic and paramagnetic impurity differ only in the form of the electronic single-particle Green's function. (P.C.H.)

24275 PROPOSAL FOR MIXED A.C. AND D.C. POWER TRANSMISSION BY SUPERCONDUCTORS. Easson, R. M.; Hlawiczka, P.; Ross, J. M. (Univ. of Glasgow). Electron. Lett., 2: 123-4(Mar. 1966).

Thermal dissipation sets the maximum current in a-c power transmission by a superconductor. Experiments show that the same maximum alternating current can be carried in the presence of a direct current, making possible combined a-c and d-c transmission. (auth)

24276 SOME PROPERTIES OF SPONTANEOUS CURRENTS. Asher, Edgar (Institut Battelle, Geneva). Helv. Phys. Acta, 39: 40-8(1966).

The symmetries that admit spontaneous electrical currents are determined. For these symmetries, Bloch's theorem does not hold. The spontaneous currents do not produce Joule heat; they give rise to a domain structure and to an effect analogous to the Meissner effect. Only 26 magnetic point groups can appear as symmetry groups of a high temperature phase that transforms to a phase admitting spontaneous conduction. Almost all superconductors have heset symmetries. Experiments are proposed that could lead to a deeper understanding of the possible relations between spontaneous conduction and superconductivity. (auth)

24277 ANALOG OF PROCOPIU EFFECT IN TYPE II SUPERCONDUCTING WIRES CARRYING AN ALTERNATING CURRENT. LeBlanc, M. A. R. (Univ. of Southern California, Los Angeles). J. Appl. Phys., 37: 1008-10(Mar. 1, 1966).

The longitudinal magnetization of a ferromagnetic wire which carries an alternating current in the presence of a stationary longitudinal magnetic field varies at twice the frequency of the applied current. This effect discovered by Procopiu has recently been studied by Skórski and Duracz. An analogous effect is observed when the ferromagnetic wire is replaced by a wire of a nonideal type-II superconductor and the current alternates below the critical value I_c. In the superconducting case, the longitudinal magnetization of the wire may oscillate from strongly paramagnetic to strongly diamagnetic as the conduction current is varied. The frequency of oscillation of the magnetization is twice that of the applied current as in the ferromagnetic case. With the current varying as $I = I_c \cos \omega t$ the longitudinal magnetization can be described by $M_z \approx A + B \cos(2\omega t)$, where A and B are temperature- and field-dependent parameters. This phenomenon in the superconducting state is shown to arise from helical patterns of induced and conduction current flow in the presence of a longitudinal field. (auth)

24278 ADIABATIC MAGNETIZATION OF Nb IN THE SUPERCONDUCTING STATE. Flippen, R. B. (E. I. du Pont de Nemours and Co., Wilmington, Del.). J. Appl. Phys., 37: 1010-11(Mar. 1, 1966).

Studies are reported of the magnetic properties of the type-II superconductor Nb upon adiabatic magnetization of the superconducting state. Both polycrystalline and single-crystal bulk samples of varying purity were used, and the effects of thermal and mechanical treatment were studied. Typical samples of Nb show large departures from isentropic conditions at all temperatures, although very high-purity material shows a cooling effect of up to 60% of that predicted from entropy data at higher temperatures, e.g., cooling from 5 to 2.5°K is obtained upon adiabatic magnetization. However, at lower temperatures irreversible magnetization effects occur even in the purest samples which lead to sample heating over part of the magnetization curve, the amount of heating increasing with decreasing starting temperature. Less pure samples of Nb show pronounced temperature jumps of up to 3°K at lower temperatures. These are shown to accompany the occurrence of large flux jumps in the ma-

terial. Annealing of samples under conditions sufficient to remove most of the physical defects produces a further departure from ideal, e.g., reversible magnetization, behavior. These energy dissipative processes are therefore ascribed to properties of flux pinning at chemical-impurity centers in bulk material. (auth)

24279 MAGNETIC DIFFUSIVITY IN A TYPE II SUPERCONDUCTOR. Lubell, M. S.; Wipf, S. L. (Westinghouse Research Labs., Pittsburgh). J. Appl. Phys., 37: 1012-14(Mar. 1, 1966).

The magnetic diffusivity $D = 10^9\rho/4\pi$ was measured for a cylinder of Nb–25% Zr at T = 4.2°K. The cylinder was brought to the shielding portion of the creep curve by a coaxial magnetic field increasing linearly with time. By means of a magnetoresistance probe, the propagation of small coaxial magnetic steps (ΔH = 2 to 20 Oe) into the center of a cylinder which remained in a critical state was observed. Fitting the diffusion equation solution for a step function to the measured delay times of the penetrating field, a value for the resistivity, $\rho\Delta = 1.5 \times 10^{-10}$ (dH/dt) Ω·cm for dH/dt in the range 2 to 40 Oe/sec was obtained. The dependence on both the magnitude of the step and the field was weak. Extrapolation of the data to $\Delta H = 0$ yields $\rho\Delta = 1 \times 10^{-10}$ dH/dt Ω·cm. If on the other hand, the resistivity for the creep state is calculated either by dividing the induced voltage multiplied by geometric factors by the shielding current, or by a steady-state solution of the diffusion equation for a ramp function, one obtains $\rho_{cr} \approx 1 \times 10^{-13}$ dH/dt Ω·cm. This discrepancy is readily explained by the steepness of the resistive transition curve, i.e., a small disturbance is sufficient to raise the resistivity well above the critical state. (auth)

24280 STUDY OF THE ELECTRIC AND SUPERCONDUCTIVITY PROPERTIES OF METALS WITH DIFFERENT PURITIES. Reich, R. (Univ. Paris, Orsay, France). Mem. Sci. Rev. Met., 63: 21-58(Jan. 1966). (In French).

Characteristic Debye temperatures and Borelius-Grüneisen relations for tin, gallium and beryllium are given. The study by resistivity measurements of the transition from the normal to the superconductance condition and the influence of metal purity and current intensity are described. (auth)

24281 MOTION OF QUANTIZED FLUX LINES IN SUPERCONDUCTORS. Bardeen, John (Univ. of Illinois, Urbana). pp 201-19 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

It is shown that as a result of the motion of quantized flux lines in superconductors, there is an electric field perpendicular to the direction of the motion of the line. (G.O.Y.)

24282 PHENOMENOLOGICAL MODEL FOR CREATION OF VORTICES BY IONS IN LIQUID HELIUM II. Di Castro, C. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (10), 42B: 251-6 (Apr. 11, 1966).

A possible explanation of the observed discontinuities of the mobility of ions in liquid helium II as a function of the applied electric field, occurring at temperature $T \simeq 1$°K, is given by means of creation of quantized vortex rings, with different circulation quantum. (auth)

24283 THERMAL CONDUCTIVITY IN DIRTY SUPERCONDUCTING ALLOYS IN HIGH FIELD. Caroli, C.; Cyrot, M. (Univ. Paris, Orsay, France). Phys. Kondens. Mater., 4: 285-96(1965).

The thermal conductivity K of a dirty type II superconductor in the mixed state is discussed, for fields close to the critical field (H_{c2} or H_{c3}) where the electronic component is dominant and easily separated. To order $|\Delta|^2$, the conductivity depends only on the space average $\langle|\Delta|^2\rangle$. The formula is a generalization of earlier results by Maki and Ambegaokar and Griffin for gapless superconductors. The slope $(\partial H/\partial H)_{H_{c3}}$ is proportional to the slope of the magnetization curve $(\partial H/\partial H)_{H_{c2}}$, the ratio of these two slopes being a universal function of temperature. These results are very different from the predictions of the "effective gap" model. (auth)

24284 THERMAL FORCES ON VORTICES AND ENTROPY TRANSPORT BY VORTEX FLOW IN TYPE-II SUPERCONDUCTORS. Otter, F. A. Jr.; Solomon, P. R. (United Aircraft Research Labs., East Hartford, Conn.). Phys. Rev. Lett., 16: 681-3(Apr. 18, 1966).

An experimental investigation which yielded the observation of two thermomagnetic effects, which are associated with the motion of vortices in a type II superconductor is reported. The temperature gradient produced by the transport of entropy when vortices flow across a type II superconducting sample was measured. Observations were also made of potential differences produced by temperature gradients in the sample. These potential differences are good evidence for the existence of the inverse effect (i.e., the motion of vortices along an imposed temperature gradient). Thermal gradients, therefore, seem to be a new driving force for moving vortices. (B.G.D.)

24285 PARALLEL AND PERPENDICULAR MAGNETIC TRANSITIONS OF SUPERCONDUCTING FILMS AND FOILS OF LEAD. Cody, G. D.; Miller, R. E. (RCA Labs., Princeton, N. J.). Phys. Rev. Lett., 16: 697-701 (Apr. 18, 1966).

The perpendicular and parallel magnetic transitions for pure Pb films and foils were determined from transverse magnetization and a-c susceptibility measurements as a function of thickness (400 Å to 35 μ) and temperature (1.4 to 4.2°K). (B.G.D.)

24286 RADIO-FREQUENCY RESISTANCE IN THE MIXED STATE FOR SUBCRITICAL CURRENTS. Gittleman, Jonathan I.; Rosenblum, Bruce (RCA Labs., Princeton, N. J.). Phys. Rev. Lett., 16: 734-6(Apr. 25, 1966).

A simple model for the oscillatory motion of flux tubes in the presence of pinning centers is given. The frequency dependence of the flux-flow resistance is calculated and is shown to be in reasonable agreement with experiments on Pb–In and Nb–Ta alloys. (B.G.D.)

24287 POWER-SERIES EXPANSIONS AND SPECIFIC-HEAT SINGULARITIES NEAR THE ^{4}He CRITICAL POINT. Griffiths, Robert B. (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. Lett., 16: 787-8(May 2, 1966).

The existence of the power-series expansion used by Mistura and Sette (Phys. Rev. Letters 16, 268(1966)) for the chemical potential μ of ^{4}He in order to fit the liquid-vapor coexistence curve near the critical point is discussed as precluding the possibility of any infinite singularity in C_V, the specific heat at constant volume, at the critical point. (B.G.D.)

24288 SECOND SOUND IN SOLID HELIUM. Ackerman, C. C.; Bertman, B.; Fairbank, H. A.; Guyer, R. A. (Duke Univ., Durham, N. C.). Phys. Rev. Lett., 16: 789-91(May 2, 1966).

A discussion of temperature-pulse experiments in samples of solid ^{4}He, a material which is believed to fulfill the frequency window requirements of propagating second sound (temperature wave s) in a solid dielectric, is presented. Preliminary results of these experiments are reported. (B.G.D.)

24289 CRYSTAL STRUCTURE OF PARA-ENRICHED SOLID DEUTERIUM BELOW THE λ TRANSITION. Mucker, K. F.; Talhouk, S.; Harris, P. M.; White, David; Erickson, R. A. (Ohio State Univ., Columbus). Phys. Rev. Lett., 16: 799-801(May 2, 1966).

The results of neutron diffraction measurements of para-enriched solid deuterium (para content 83%) at 1.9°K are presented. The para-enriched solid deuterium exhibited anomalies in the nuclear magnetic resonance and λ transitions in the heat capacities. The neutron diffraction patterns above the λ-transition temperatures of the heat capacity were the same, within experimental error, as those for ortho and normal deuterium with respect to both line positions and intensities. Therefore, the high temperature form of solid deuterium is hcp regardless

of the para content. However, below the λ transition temperatures the results indicate that the crystal structure of para-enriched solid deuterium changes from hcp to fcc. (B.G.D.)

24290 GALVANOMAGNETIC AND RELATED EFFECTS IN TYPE-II SUPERCONDUCTORS. Stephen, M. J. (Yale Univ., New Haven). Phys. Rev. Lett., 16: 801-3(May 2, 1966).

The galvanomagnetic and thermomagnetic effects in the mixed state of Type II superconductors are examined. The relation of the current to the voltages appearing in the mixed state of Type II superconductors which has been previously investigated is compared to results obtained on these effects in Type II superconductors. Both the transverse effects and the longitudinal effects are discussed. (B.G.D.)

24291 CONSIDERATIONS ON THE FLOW OF SUPERFLUID HELIUM. Anderson, P. W. (Bell Telephone Labs., Murray Hill, N. J.). Rev. Mod. Phys., 38: 298-310(Apr. 1966).

First, it is shown that the most important equations of the dynamics of the two types of superfluids, He II and superconductors, follow quite directly from the simple assumption that the quantum field of the particles has a mean value which may be treated as a macroscopic variable. The background of this ansatz is also discussed. Second, these equations are applied to various physical situations in He II, notably the orifice geometry and the superfluid film, and it is shown how they, and particularly the idea of phase slippage accompanying all dissipative processes, can be applied and what kinds of macroscopic interference phenomena may be expected. The effect of synchronization in the a-c interference experiment is discussed. (auth)

24292 THE MAGNETIC BEHAVIOR OF DIRTY SUPERCONDUCTORS. Caroli, C.; Cyrot, M.; de Gennes, P. G. (Faculte des Sciences, Orsay, France). Solid State Commun., 4: 17-19(Jan. 1966).

The parameter κ_2 giving the slope of the magnetization M at the upper critical field H_{c2} was recalculated, in a dirty superconductor $-4\pi M = (H_{c2} - H)/[1.16(2\kappa_2^2 - 1)]$. It is found that κ_2 is, at all temperatures, essentially identical to $\kappa_1 = H_{c2}/H_c$. (auth)

24293 SUPERCONDUCTIVITY OF SOME NEW HEXAGONAL TUNGSTEN BRONZES. Bierstedt, P. E.; Bither, T. A.; Darnell, F. J. (Du Pont de Nemours (E. I.) and Co., Wilmington, Del.). Solid State Commun., 4: 25-6 (Jan. 1966).

The nonstoichiometric tungsten bronzes M_xWO_3 with hexagonal structure (maximum x = 0.33) have been described by Magnêli for the alkali metals potassium, rubidium, and cesium. These materials exhibit metallic-type conduction, and, as recently reported by Sweedler et al. bronzes, having hexagonal or tetragonal I symmetry show superconductivity of a series of new hexagonal tungsten bronzes containing the alkaline earths, calcium, strontium, or barium. In addition, the hexagonal thallium and indium bronzes prepared in this laboratory are shown to be superconducting. (auth)

24294 PROPAGATION OF AN ELECTROMAGNETIC WAVE IN A TYPE II SUPERCONDUCTOR IN THE MIXED STATE. Simon, Y. (Laboratoire de Physique de l'Ecole Normale Superieure, Paris). Solid State Commun., 4: 27-30(Jan. 1966).

A low frequency wave transmitted through a PbIn sample in the mixed state is observed. Its amplitude is bound to the vortex motion and is increased by driving the vortices by a d-c current. (auth)

24295 TEMPERATURE DEPENDENCE OF THE SUPERCONDUCTING ENERGY GAP OF Pb. Gasparovic, R. F.; Taylor, B. N.; Eck, R. E. (Univ. of Pennsylvania, Philadelphia). Solid State Commun., 4: 59-63(Jan. 1966).

The temperature dependence of the superconducting energy gap of Pb was determined using Pb–Pb tunnel junctions. Deviations from the BCS theory were consistent with the physical arguments used by Schrieffer and Wada to explain the large ratio of energy gap to transition temperature for strong coupling superconductors and with the detailed numerical calculations of Swihart, Scalapino and Wada. (auth)

24296 NOTE ON THE PARAMAGNETIC RESONANCE OF SUPERCONDUCTORS OF THE TYPE II. de Gennes, P. G. (Faculte des Sciences, Orsay, France). Solid State Commun., 4: 95-7(Feb. 1966).

Paramagnetic resonance can probably be observed in light superconductors. The case of bulk type II materials in high field is discussed and it is shown that: motional narrowing is efficient; in dirty samples the rf field is only slowly varying from one vortex to the next; and in these conditions the resonance signal gives an information on the excitation spectrum that is similar to what is obtained from the initial slope of a tunneling I(V) characteristic. (auth)

24297 CRITICAL TEMPERATURE FOR ORDINARY AND ANOMALOUS SUPERCONDUCTORS. Geilikman, B. T.; Kresin, V. Z. (Moscow State Pedagogical Inst.). Soviet Phys.-Solid State (Engl. Transl.), 7: 2659-63(May 1966).

Translated from Fiz. Tverd. Tela, 7: 3294-301(Nov. 1965).

The critical temperature of a superconductor is calculated in the Frölich model. An expression is obtained relating the energy gap at T = 0 and T_k. The results describe the properties of anomalous superconductors. (auth)

Neutron Physics

See also REACTOR TECHNOLOGY — Criticality Studies

Refer also to abstract 24355.

24298 (AD–625406) THE PHYSICS AND SHIELDING ASPECTS OF HETEROGENEOUS ISOTOPIC NEUTRON SOURCES. Knuth, Donald F. (Catholic Univ. of America, Washington, D. C. Div. of Nuclear Science and Engineering). July 1965. Contract Nonr-2249(13). 56p. CFSTI $3.00 cy, $0.50 mn.

The feasibility of constructing an isotopic neutron source that can be turned on or off at the option of the user was studied. The (α,n) reaction was selected to be the source of neutrons. It was desired that a suitable combination of radioisotope material and target material be selected which exhibited a high neutron yield when the two materials were placed into the on mode, and yet exhibited low radiation intensities when the source was in the off mode. Source half-life, material availability, and cost were considered. It was concluded that ^{210}Po and ^{238}Pu appeared to be the most attractive radioisotope materials. For a mechanical on-off system, beryllium was considered to be the best target material since it exhibits the highest yield in an (α,n) reaction. Typical neutron energy spectra and neutron yields were calculated which showed that the ratio of neutrons emitted while in the on mode compared to the off mode was on the order of 10,000. Calculations were made of neutron and gamma intensities. (TAB)

24299 (AD–625415) VARIABLE INTENSITY ISOTOPIC SOURCES. Annual Summary Report, December 1, 1964–June 30, 1965. Jordan, E. D.; Carew, T. E. (Catholic Univ. of America, Washington, D. C. Div. of Nuclear Science and Engineering). Aug. 1965. Contract Nonr-2249(13). 25p. CFSTI $1.00 cy, $0.50 mn.

The feasibility was studied of isotopic radiation sources of variable output. In a detailed investigation of possible (α,n) reactions, beryllium was determined to be the best target material, while ^{210}Po and ^{238}Pu were the best alpha source materials. Engineering considerations applicable to heterogeneous neutron source designs are described. These include encapsulation for physical containment of polonium within the source, heat generation and heat

transfer, and mechanisms of damage to stainless steel or gold windows used for containment of polonium. For variable-output bremsstrahlung sources, four nuclides identified as most suitable are ^{45}Ca, ^{147}Pm, ^{90}Sr, and ^{170}Tm. (TAB)

24300 (AD-626147) NEUTRON CAPTURE IN THE ATMOSPHERE FROM HIGH-ALTITUDE POINT SOURCES. Marcum, J. I. (RAND Corp., Santa Monica, Calif.). Oct. 1965. Contract AF49(638)-700. 29p. (RM-4385-PR). CFSTI $2.00 cy, $0.50 mn.

Results are given for the spatial and time-dependence of neutron capture from a representative fission weapon spectrum and a 14-Mev monoenergetic source at altitudes of 10 to 48.3 km in the real atmosphere. The solutions were obtained by the use of the RAND Monte Carlo Neutron Transport Code. A reasonable approximation to the energy disposition may be simply obtained by assuming that all the energy is locally deposited. If more precise results are desired, the gamma ray component of the thermal capture process should be treated as a further radiation transport problem. (auth)

24301 (CEA-R-2926) DETERMINATION D'UNE BASE DE FONCTIONS PROPRES ET DE LA NORME CORRESPONDANTE DANS LE CAS DE L'EQUATION INTEGRO-DIFFERENTIELLE DE BOLTZMANN A UNE VITESSE ET EN GEOMETRIE SPHERIQUE. (Determination of a Basic Set of Eigenfunctions and of the Corresponding Norm in the Case of the One-Velocity Integral Differential Boltzmann Equation in Spherical Geometry). Lafore, Pierre (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec. 1965. 60p. Dep. mn.

A basic set of orthogonal eigenfunctions is derived for resolving the one-velocity integral-differential Boltzmann equations for spherical configurations. (M.O.W.)

24302 (GA-6273) A NUMERICAL STUDY OF THE METHOD OF WEIGHTED RESIDUALS. Pomraning, G. C. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Mar. 29, 1965. Contract AT(04-3)-187. 40p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The variational method and the region-balance method, both special cases of the more general method of weighted residuals, are each used as the formalism to develop a spatial expansion of the diffusion equation for two problems. These are a spatially dependent spectrum problem for the purpose of computing the self-shielding in the ^{240}Pu resonance and a simple one-dimensional eigenvalue problem. In both instances, the numerical results indicate that the variational method is more accurate than the region-balance method. Of particular interest is the variational spatial expansion approach to the eigenvalue problem. This may be a useful method for deriving a set of difference equations for the multigroup diffusion equation in that it should lead to an accurate representation of the flux with a relatively small number of mesh points. (auth)

24303 (GA-6897) MEASUREMENT OF NEUTRON SPECTRA IN LIQUID HYDROGEN. Quarterly Progress Report for the Period Ending December 17, 1965. Trimble, G. D.; Profio, A. E. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Jan. 7, 1966. Contract NAS-3-6217. 38p. (NASA-CR-54889).

A brief description of the liquid hydrogen facility is given. Some thermal neutron measurements are presented. Also, theoretical calculations of the spectra in the fast neutron region are given. (M.O.W.)

24304 (LA-DC-7799) USE OF NUCLEAR EXPLOSIONS AS PULSED NEUTRON SOURCES. Diven, Benjamin C. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [nd]. Contract W-7405-eng-36. 4p. (CONF-660303-19. ORAU.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The use of nuclear explosions as neutron sources for cross-section measurements is briefly discussed. The status and future development of the method are considered, as well as plans for future measurements. (D.C.W.)

24305 SCATTERING OF SLOW NEUTRONS AND NON-EQUILIBRIUM PROPERTIES OF MANY-BODY SYSTEMS. Fulinski, Andrzej (Jagellonian Univ., Krakow). Acta Phys. Pol., 29: 163-76(Feb. 1966).

The properties of scattering function for systems not in a thermodynamical equilibrium are discussed, and those non-equilibrium properties that can be determined by scattering experiment are sought. It is found, among other results, that the scattering of slow neutrons could give the answer to the question if the so-called local equilibrium hypothesis is fulfilled. The non-equilibrium one-particle distribution functions $\langle N(p) \rangle$ can also be determined from neutron scattering data. (auth)

24306 SCATTERING OF SLOW NEUTRONS IN EXTERNAL FIELDS. Fulinski, Andrzej (Jagellonian Univ., Krakow). Acta Phys. Pol., 29: 205-21(Feb. 1966).

The scattering of slow neutrons by many-body systems in the presence of an external dynamical field is given in terms of Van Hove's scattering functions, and on the basis of the Kubo theory. It is found, among other results that the incoherent scattering function is related with non-equilibrium one-particle distributions $\langle N(p) \rangle$ only when the external field operator fulfils some rather restrictive conditions, in spite of "free" systems (without external fields) where such a relation exists always. As an example, the influence on the scattering of the acoustical field is discussed. It is found that an acoustical field applied to the scattering sample causes a smoothing down and broadening of the energy distribution of scattered neutrons, which could perhaps be of some importance for the cooling down of neutrons. (auth)

24307 THERMAL FLUXES OF 10^8 n/sec cm^2 FROM ^{124}Sb-Be. Courtemanche, R. (Atomic Energy of Canada, Ltd., Ottawa); Kushneriuk, S. A. Can. Nucl. Technol., 5: No. 2, 32-4(Mar.-Apr. 1966).

The advantages of Sb–Be over alpha-neutron sources and neutron generators are discussed. It is shown that a 31-gram antimony slug irradiated to 1,000 curies of Sb-124 can yield more than 10^{10} n/sec and produce an extended thermal flux better than 10^8 n/sec cm^2. In particular, it will be seen that the high thermal flux can be used to full advantage: the samples to be irradiated can be put close to the source where the thermal flux is maximum, since the primary neutrons have an energy below the threshold energy for fast neutron reactions. If need be, the thermal flux can be converted to a fast flux by the use of a ^{235}U foil around the sample. (auth)

24308 APPLICATION OF THE C(λ) METHOD TO PROBLEMS IN NEUTRON THERMALIZATION. Wood, J. (Univ. of Birmingham, Eng.). J. Nucl. Energy, Pt. A/B, 20: 219-22(Mar. 1966).

The application of the C(λ) method for finite systems is demonstrated by solving, for beryllium, problems in neutron thermalization. These problems are to obtain the maximum buckling beyond which no discrete time-decay constant can exist for a pulse source, obtain the maximum absorption beyond which no diffusion length can exist and establish the existence, or otherwise, of higher spatial decay constants, and the general solution of the flux ϕ (e, x, μ, t), in a pulsed slab. (B.G.D.)

24309 SOME COMMENTS ON THE ASYMPTOTIC DECAY CONSTANT IN SMALL CRYSTALLINE ASSEMBLIES. Williams, M. M. R. (Univ. of London). J. Nucl. Energy, Pt. A/B, 20: 222-3(Mar. 1966).

An explanation is presented on why the suggestion by Ghatak (J. Nucl. Energy, Parts A/B Reactor Sci. Technol., 19: 675(1965)) that a new bound for the discrete time eigenvalues, λ_n, of decay constants in pulsed neutron experiments is incorrect. A consistent approach whereby the experimental information contained in the continuous range may be utilized is discussed. (B.G.D.)

24310 NEUTRON ESCAPE FROM MANGANESE SULFATE BATHS USED IN THE CALIBRATION OF RADIOACTIVE NEUTRON SOURCES. Davy, D. R. (Australian Atomic Energy Research Establishment, Lucas Heights). J. Nucl. Energy, Pt. A/B, 20: 277-83(Apr. 1966).

The escape from manganese sulfate baths of neutrons from Pu(α,n)Be sources was measured as a function of the radius, r cm, of the bath; the fractional escape is given by $f = 2.1 \exp(-0.0952\ r)$. The escape, from a specific bath size, as a function of average neutron energy was also investigated using (γ,n) sources. The results yield an estimate of the variation of relaxation length with neutron energy of neutrons in aqueous manganese sulfate solution. (auth)

24311 EFFECTIVE THERMAL-NEUTRON CROSS SECTIONS FOR MATERIALS WITH GRAIN STRUCTURE. Dyos, M. W.; Pomraning, G. C. Nucl. Sci. Eng., 25: 8-11(1966).

A method is given for the calculation of effective neutron cross sections for materials with grain structure. The method is particularly suited for the calculation of effective cross sections at thermal energies where the ratio of scattering-to-total cross section for absorbers is small. The grain shielding factors were calculated through the 1.056-ev resonance of ^{240}Pu for the case of 200-μ-diam plutonium oxide grains, containing 17% ^{240}Pu, homogeneously dispersed in BeO. It is shown that provided the centers of the grains are not less than 800μ apart the method given is applicable and gives excellent agreement with the results obtained from a P_1, S_8 neutron-transport theory calculation. (auth)

24312 NEUTRON SPECTRA IN LIGHT OR HEAVY WATER WITHIN A CONTAINER LOCATED INSIDE A URANIUM TUBE. Johansson, E.; Jonsson, E.; Lindberg, M. Nucl. Sci. Eng., 25: 21-30(1966).

Chopper measurements were made of neutron spectra in either D_2O, H_2O, or D_2O-H_2O mixtures within a container that was placed inside a uranium tube in the reactor R1. The fluid layer was 11.3-mm thick and its temperature either 22 or about 80°C. The neutron energy ranged from 0.008 to 1000 ev. With D_2O in the container, the spectrum was only slightly softer than in the empty container. When the D_2O was replaced by H_2O, the spectrum changed considerably. The experiment had a clean geometry, which makes it possible to apply calculational methods. The THERMOS transport theory code was used to compute the neutron spectra. The computed thermal spectra were slightly softer than the chopper spectra—the difference is not important for reactor calculations. All calculations underestimated the neutron flux in the joining region (≈0.3 ev). This effect can be important in calculations on reactors with plutonium. (auth)

24313 INFLUENCE OF RESONANCE SCATTERING ON THE NEUTRON SPECTRUM. Brogli, R. (Univ., Bern). Nukleonik, 8: 45-50(Jan. 1966). (In German).

The effect of the resonance scattering was investigated on the basis of three different scattering nuclei and the thermal motion of the target nucleus was also considered. The resonance scattering in the scattering kernel was not considered as is usual in the common methods in reactor calculation. A scattering kernel which describes the resonance scattering with consideration of the thermal motion was derived for the evaluation of this effect. The difference with and without consideration of resonance scattering in the scattering kernel was analyzed on the basis of two examples. (tr-auth)

24314 FUNDAMENTALS FOR THE EVALUATION OF INTENSITY ACCURACY QUESTIONS IN NEUTRON SCATTERING MEASUREMENTS. Maier-Leibnitz, H. (Technische Hochschule, Munich). Nukleonik, 8: 61-7(Feb. 1966). (In German).

It was shown that the considerations in the pulse space for the planning and analysis of experiments with thermal neutrons are advantageous in which the pulse and energy resolutions and the intensity can be very simply monitored. After formulation of the general intensity formulas for collimated beams and for the inelastic scattering studies, various neutron selectors were treated as examples: for instance, neutron guides, collimators, choppers, pulsed reactors, and monochromator crystals. A simple intensity comparison between equivalent pulsed and continuous studies and viewpoints for the optimization of experiments are given. (tr-auth)

24315 THEORY OF FLUCTUATIONS IN NEUTRON FIELDS. Matthes, W. (EURATOM-CCR, Ispra, Italy). Nukleonik, 8: 87-94(Feb. 1966).

A theory of the statistical fluctuations in neutron fields is developed within the framework of the Kolmogoroff-equations for stochastic processes. The "forward"-equation (F.E.Q.) for the first order neutron density turns out to be identical with the Boltzmann equation while the "backward"-equation (B.E.Q.) is the adjoint-equation. An analysis of the B.E.Q. for higher order densities reveals the structure of the solution of the F.E.Q. for higher order densities and the solution itself. This result is used to determine the second order or binary neutron density, important in correlation measurements. Further, it is shown that the B.E.Q. is the equation for the "importance" field, where the importance I(P,t) of a neutron starting at {P,t} is the effect on an "instrument" through the neutron cloud generated by this source neutron. Mathematically the instrument is described by the source term in the equation for the importance field. Therefore an instrument acts as a source for the importance field just as a neutron source does for the neutron field. (auth)

24316 SURVEY ON THE VARIATION OF THE ANALYTICAL SOLUTIONS OF THE TIME-INDEPENDENT BOLTZMANN EQUATION IN SPHERICAL GEOMETRY. di Guglielmo, Francis (Technische Hochschule, Karlsruhe, Ger.). Nukleonik, 8: 108-19(Feb. 1966). (In French).

The method of W. Kofink for the solution of the time-independent Boltzmann equation in spherical geometry for monoenergetic neutrons is recalled; then the corresponding solutions are derived for the singular and the regular case. The computational difficulties for the use of these solutions are discussed and tables are given for a restricted range of the variables. Finally the advantages and drawbacks of the new solutions in comparison with the spherical harmonics expansions are pointed out. (auth)

24317 ON THE DISCRETE SPECTRUM OF OPERATORS OF MONOENERGETIC NEUTRON TRANSPORT IN ANY RESTRICTED GEOMETRY. Li, Hao; Kwan, Chao-Chih. Sci. Sinica (Peking), 15: 21-4(1966). (In German).

Jörgens has shown with the help of the theory of semigroups of linear operators that the spectrum of the operators of monoenergetic neutron transport in any limited geometry possesses a purely discrete spectrum. In the present study the operator form used by Vladimirov $(-L + S)\phi$, $\phi = \phi(s,P)$, $\vec{s} \in \Omega$, $P \in G$, where $L\phi = [1/\alpha(P)]\ \vec{s} \cdot \text{grad}\ \phi + \phi$, $S\phi = (1/4\pi) \int_\Omega \vartheta(P,(\vec{s},\vec{s}'))\phi(\vec{s}',P)d\vec{s}'$, the symbols Ω, G, α, ϑ, and the boundary conditions are the same as those described previously. It is known that the inverse operator L^{-1} in the space $h = L^2_\alpha(\Omega \times G)$ is limited and therefore the eigenvalue problem is $(-L + S)\phi = \lambda\phi$ (Eq. 1) with the equilibrium $L^{-1}\phi = \nu(I - L^{-1}S)\phi$, $\nu = -(1/\lambda)$. Under the condition $h_0 \equiv \underset{P \in G}{\text{l.u.b.}}\ \text{Re}(1/2) \int_{-1}^{1} |\Theta(p,\mu_0)|d\mu_0 \leq 1$, $L^{-1}S$ is however a completely stable operator with the eigenvalue γ_k with an absolute concentration smaller than 1 and therefore $(I - L^{-1}S)^{-1} = I + T$, where T is also completely stable. Therefore Eq. 1 is equivalent to the problem $(L^{-1} + TL^{-1})\phi = \nu\phi$ (Eq. 2). The following law is derived: $\sigma(L^{-1}) = C\sigma(L^{-1}) = \sigma_w(L^{-1}) = \{0\}$, where $\sigma_w(L^{-1})$ signifies the essential spectrum of the operator L^{-1}. According to the result of Gochberg-Krein and the relation (Eq. 1) and (Eq. 2) the following law is also obtained: $-L + S$ has a purely discrete spectrum and has ∞ as the single possible accumulation point. (tr-auth)

24318 CALCULATION OF FAST NEUTRON MULTIPLICATION FACTOR IN A DENSE GRID NETWORK. Hsieh, Chung-sheng. Yuan Tzu Neng, No. 1, 37-42(1965).

The fuel, shield, and moderator problems are discussed

and the cylindrical grid made by a fuel rod and a shield is studied. A sketch of the grid is shown. Assuming that the neutron flux is zero along the periphery of the tank, the external surface of the rod $S_3(\tau = r_3)$ is a perfect neutron reflector, and neutrons escaping from the uranium rod are not absorbed by the shield. The neutron absorption, multiplication, and escape in this grid configuration are considered. (CFSTI)

24319 THE DECAY OF NEUTRONS IN LIQUID URANIUM. Huang, Tsu-hsia. Yuan Tzu Neng, No. 3, 198-204 (1965).

The objective was to investigate the variation in the duration of neutron decay as interpreted in the theory of neutron physics and pile physics, by considering the characteristics of hydrogen decay and the effect of non-elastic diffraction of uranium. As a consequence, the expressions for neutron decay duration were derived from the viewpoints of both branches of physics. The relation between the decay duration and the pile geometric size and patterns is discussed. The results derived from the viewpoint of neutron physics and from the viewpoint of pile physics are presented. (ATD)

24320 GAS DISCHARGE TUBE FOR GENERATING NUCLEAR REACTIONS. Schmidt, Albrecht (to Kernreaktor Bau-und Betriebsgesellschaft mbH). British Patent 1,022,168. Mar. 9, 1966. Filed Oct. 23, 1962.

A gas discharge tube comprises a casing containing a gas under low pressure, high frequency generating and coupling means for converting a portion of the gas into plasma with a plasma boundary, a cathode target adjacent to the plasma boundary, and an anode spaced from the target. The target is positioned at a distance from the plasma boundary not greater than twice the diameter and preferably less than the diameter of the ion beam before striking the target. An electric potential difference is applied between the target and the anode to generate an accelerated ion beam from the plasma boundary against the target to initiate nuclear reactions in the target electrode. The tube design is particularly applicable to a neutron generating tube, which in pulsed operation would give bursts of neutrons released from the target. (B.L.M.)

24321 NEUTRON GENERATOR. Matsushita, Masaharu (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 1964-11999. June 14, 1965. Filed July 13, 1963.

The proposed neutron generator produces neutrons by the $D(t,n)^4He$ reaction. The ion, i.e., ^2_1D, current, which is accelerated, is allowed to impinge upon an annular target, making a circular or spiral flow by means of two magnetic or electric deflectors installed in the passage of the ion current. (NSA of Japan)

Nuclear Properties and Reactions

Refer also to abstracts 22858, 23457, 24088, 24311, 24313, 24314, and 24586.

24322 (AD-624270) STUDY OF NUCLEAR EXCITATIONS IN ^{10}B, ^{11}B, AND ^{14}N BY INELASTIC ELECTRON SCATTERING AT 180 DEG. Kossanyi-Demay, P.; Vanpraet, G. J. (Stanford Univ., Calif. High-Energy Physics Lab.). Oct. 1965. Contract Nonr-225(67). 30p. (HEPL-391). CFSTI $2.00 cy, $0.50 mn.

Nuclear energy levels of ^{10}B, ^{11}B, and ^{14}N were studied using electron inelastic scattering at 180°. Radiation widths were derived for the excited states, and the results were compared with the predictions of the single-particle model. For the magnetic dipole transitions in ^{10}B and ^{11}B, the experimental data were compared with some calculations of M1 transition strengths in p-shell nuclei. (D.C.W.)

24323 (AD-624314) HARTREE-FOCK CALCULATIONS OF FINITE NUCLEI [Thesis]. Muthukrishnan, R. (Case Inst. of Tech., Cleveland, Ohio. Dept. of Physics). Sept. 1965. Contract Nonr-760(15). 123p. CFSTI $4.00 cy, $0.75 mn.

A matrix formulation of the Hartree-Fock method is used to calculate properties of finite nuclei. The two-body interaction used is of the non-local separable type, which gives saturation. The s-wave interaction is chosen such as to give the energy and density of nuclear matter correctly and have small second-order corrections. Calculations are done for ^{12}C, ^{16}O, ^{28}Si, ^{40}Ca, ^{60}Zn, and ^{80}Zr with the s-wave force. The single-particle energies and wave functions are obtained. Since only the s-wave force is included, there is no spin-orbit splitting of the single-particle levels. The closed-shell nuclei ^{16}O, ^{40}Ca, and ^{80}Zr are more bound than the non-closed shell nuclei ^{12}C, ^{28}Si, and ^{60}Zn. Calculations for ^{12}C and ^{28}Si are done with pure anisotropic harmonic oscillator functions as the wave functions; these nuclei prefer a deformed shape over a spherical shape. The single-particle levels are much deeper than would be expected from a local single-particle potential. This shows the strong non-locality of the single-particle potential. The properties of ^{16}O and ^{40}Ca are calculated with forces acting in both relative s and p states. (TAB)

24324 (AD-625463) NEUTRON SPECTRA FROM MONOENERGETIC PHOTONS OF BISMUTH [Thesis]. Kuchnir, Franca Tagliabue (Illinois Univ., Urbana. Dept. of Physics). Dec. 1965. Contract Nonr-1834(05). 162p. CFSTI $5.00 cy, $1.00 mn.

The technique for obtaining monochromatic photons from the 25-Mev betatron of the University of Illinois was extended to permit the measurement of neutron spectra from (γ,n) reactions over the giant resonance region. Neutron detection entailed new techniques, such as the discrimination against the high gamma background, the development of a time-of-flight measuring apparatus, and a method for data analysis. The new technique used in this experiment presents the advantage that both the photon and neutron energies are known, and furthermore that the photon energy can be varied continuously. The experimental results were found to be in agreement with available theoretical calculations based on the particle-hole model. Schematically, this model was proposed to show how the residual particle-hole interaction could combine single-particle excitations, arising in the absorption of a dipole gamma ray, so as to produce a coherent giant dipole state. (TAB)

24325 (AD-625706) ELECTROMAGNETIC MASS AND THE INERTIAL PROPERTIES OF NUCLEI. Sherwin, Chalmers W.; Rawcliffe, Robert D. (Illinois Univ., Urbana. Coordinated Science Lab.). Mar. 14, 1960. Contract DA-36-039-SC-56695. 21p. CFSTI $1.00 cy, $0.50 mn.

According to the theory of relativity, the inertial mass of any physical system should be a scalar quantity (no matter how distorted its electromagnetic structure); and the "excess" inertial mass of electromagnetic origin should not be observable. Experimental evidence on both these points was examined for nuclei. It was found that the inertial mass of a distorted nucleus, as measured by a mass spectrometer, has no observable asymmetry to an accuracy of 1 part in 100 of the asymmetry which is calculated to exist as a consequence of the electromagnetic energy. It was found that a comparison of nuclear mass differences (as measured by the mass spectrometer and by nuclear reactions) shows that the "excess" electromagnetic inertial mass is not observable, to an accuracy of 1 part in 600. (TAB)

24326 (AD-626056) HIGH-ENERGY PHYSICS WITH EMPHASIS ON STRANGE PARTICLES. Final Scientific Report. Skjeggestad, O.; Sorensen, S. O. (Oslo Univ., Blindern (Norway). Fysisk Institutt). Aug. 31, 1965. Contract AF-EOAR-100-63. 38p. (AFOSR-65-1912). CFSTI $2.00 cy, $0.50 mn.

Some research on the energy spectrum of mesons ($\pi^\pm$) from meson (K^-) capture in CF_3Br, hypernuclei from Ξ^- capture in nuclear emulsions, phase space, and excited states of $_\Lambda Be^9$ is summarized. A FORTRAN program for the analysis of hyperfragments from their production or decay is also briefly described. (D.C.W.)

24327 (AD-630436) ELECTROMAGNETIC DECAY OF THE 1.7- AND 2.43-Mev LEVELS IN ^9Be. Purdom,

Paul Jr.; Seeger, P. A.; Kavanagh, R. W. (California Inst. of Tech., Pasadena). Jan. 31, 1966. 33p.

The 1.7- and 2.43-Mev levels in ^{9}Be were populated using the reaction ^{11}B(d,α)^{9}Be* by bombarding thin boron on carbon foils with 1.7-Mev deuterons. The alpha particles were analyzed in energy with a surface-barrier counter set at the kinematically determined angle corresponding to recoiling ^{9}Be nuclei at $\theta_{lab} = 90°$. The latter were analyzed in rigidity with a magnetic spectrometer, in energy by a surface-barrier counter at the spectrometer focus, and in velocity by the time delay between an alpha and a ^{9}Be count. When a pulse from the spectrometer counter was in the appropriate delayed coincidence with a pulse from the alpha counter, the two pulses were recorded in a two-dimensional pulse-height analyzer. Most of the ^{9}Be* decay by particle breakup. Only those that gamma decay are detected by the spectrometer counter. Thus the experiment provides a direct measurement of Γ_{rad}/Γ. An analysis of 384 observed events gives a value of $\Gamma_{rad}/\Gamma = 1.16 \pm 0.14 \times 10^{-4}$ for the 2.43-Mev level. Combining this ratio with the value of $\Gamma_{rad} = 0.122 \pm 0.015$ ev found from electron inelastic scattering gives a value of $\Gamma = 1.05 \pm 0.18$ kev. For the 1.7-Mev level, an upper limit of $\Gamma_{rad}/\Gamma \leq 2.4 \times 10^{-5}$ was determined. (auth)

24328 (ANL–7108) PHYSICS DIVISION SUMMARY REPORT, APRIL–DECEMBER 1965. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 118p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Separate abstracts were prepared for the nine sections of the report. (D.C.W.)

For abstracts of individual sections see: 23420, 23456, 23873, 23874, 24329–24332, and 24586.

24329 (ANL–7108, pp 1-4) GAMMA-RAY SPECTRA FROM CAPTURE IN NEUTRON RESONANCES. Jackson, H. E.; Namenson, A. I.; Thomas, G. E.; Smither, R. K. (Argonne National Lab., Ill.).

A gamma spectrometer using germanium diodes was developed for the study of neutron-capture gamma rays with energies above 1 Mev. Neutron-capture gamma spectra were measured and were used to obtain accurate neutron separation energies for Al, ^{10}Be, ^{13}C, ^{178}Hf, ^{179}Hf, ^{180}Hf, ^{181}Hf, Fe, Mg, N, ^{15}N, Si, and ^{24}Na. The energy levels of ^{178}Hf, ^{179}Hf, ^{180}Hf, and ^{181}Hf were also investigated. (D.C.W.)

24330 (ANL–7108, pp 31-6) SCATTERING OF CHARGED PARTICLES. Siemssen, R. H.; Braid, T. H.; Dehnhard, D.; Zeidman, B. (Argonne National Lab., Ill.).

The angular distributions for the elastic scattering of ^{3}He by ^{58}Ni, ^{60}Ni, ^{62}Ni, and ^{64}Ni at 33 Mev were measured, and the angular distributions were calculated using the optical model with potentials of the Woods-Saxon type. The angular distributions for the inelastic scattering of 33-Mev ^{3}He particles from the 2^+ and 3^- levels in each of the isotopes were also measured; the distributions follow the Blair rule. (D.C.W.)

24331 (ANL–7108, pp 61-6) PROPERTIES OF LIGHT NUCLEI. Kurath, Dieter (Argonne National Lab., Ill.).

The strengths of E2 transitions in ^{10}B were calculated, and the relation of the beta decay of ^{10}C to certain E2 transition strengths in ^{10}B was studied. (D.C.W.)

24332 (ANL–7108, pp 67-73) SHELL-MODEL CALCULATIONS. Lawson, R. D.; Soper, J. M. (Argonne National Lab., Ill.).

The properties of some arbitrary nuclei with A = 41–48 and N = 4 to 12 were calculated using a model in which the $1d_{3/2}$ and $1f_{7/2}$ single-particle levels are assumed to be isolated from all other single-particle states. Exact calculations were made as well as calculations in which a pure $f_{7/2}$ configuration was assumed. The results show that many nuclear properties are extremely insensitive to configuration mixing arising from the excitation of zero-coupled pairs out of a closed shell. (D.C.W.)

24333 (BNL–10075) ISOBARIC SPIN SELECTION RULES FOR ELECTROMAGNETIC TRANSITIONS. Warburton, E. K. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT-30-2-GEN-16. 23p. (CONF-660306–4). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference on Isobaric Spin, Tallahassee.

The isobaric-spin selection rules for electromagnetic transitions between nuclear levels are discussed along with experimental evidence supporting these rules. (M.O.W.)

24334 (BNL–10083) DIFFERENTIAL AND INTEGRAL CROSS SECTIONS FOR THE TRANSURANIUM ELEMENTS. Pearlstein, S. (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 16p. (CONF-660303–8). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

Cross sections useful for determining the production of transuranium elements are evaluated using the Breit-Wigner single level formula. Thermal cross sections and resonance integrals for neutron capture and fission are presented for the ^{234}U, ^{236}U, ^{237}Np, ^{238}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, ^{243}Am, and ^{244}Cm nuclides. (auth)

24335 (BNL–10085) THE NEUTRON CROSS SECTION OF SODIUM BELOW 40 kev. Stephenson, Thomas E. (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 18p. (CONF-660303–9). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The neutron cross section of sodium from 1 ev to 40 kev is calculated. A good fit to the data is obtained with the spin-dependent scattering radii $R_+' = 5.85$ f and $R_-' = 5.18$ f. A good fit is not found using a spin-independent scattering radius. The excess absorption resonance integral is calculated to be 0.072 barns and is in good agreement with experimental values. The scattering resonance integral is calculated to be 72 barns which compares favorably with an evaluated experimental result. The low energy potential scattering is described by spin-dependent square potential wells. (auth)

24336 (CEA-Bib–68) REACTIONS NUCLEAIRES INDUITES PAR ^{3}He [THESE]. (Nuclear Reactions Induced by ^{3}He [Thesis]). Andre, Stephane (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1966. 23p. Dep. mn.

It is shown that in the actual state of the theory the surface reactions accompanied by the transfer of a single nucleon, for bombardment energies of over about 10 Mev, are well explained by the DWBA method and provide the most important spectroscopic information. On the other hand, the double-stripping process is still obscure, while at low energies the compound nuclei effects are superimposed on the direct mechanism and make interpretation very difficult. (auth)

24337 (CEA-R–2964) CONTRIBUTION A L'ETUDE DES TRANSITIONS β UNE FOIS INTERDITES. CAS DE ^{42}K ET ^{86}Rb [Theses]. (Contribution to the Study of Once-Forbidden β Transitions. Case of ^{42}K and ^{86}Rb [Thesis].). Andre, Stephane (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Oct. 9, 1965. 86p. Dep. mn.

Submitted to Grenoble Univ. (France). Faculte des Sciences.

An apparatus was developed for studying the exact shape of the spectra of β transitions which lead to an excited state of the final nucleus, using a Siegbahn-Slätis β spectrometer. In particular the β spectrum of the $2- \rightarrow 2+$ transition of ^{42}K was measured; a considerable deviation was found with respect to the statistical shape. The six elements of the nuclear matrices for this transition were determined using this measurement and other results. It is shown that it cannot be explained by a pure $f_{7/2} \rightarrow d_{3/2}$ transition. Furthermore the value obtained for the ratio of the matrix elements $\int\vec{\alpha}$ and $\int\vec{r}$ is in excellent agreement with that predicted from the theory for the maintained vectorial current. (auth)

24338 (CONF-660411-1) SHELL MODEL CALCULATION OF NEUTRON SCATTERING. Reynolds, J. T. (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 26, 1966. Contract W-31-109-eng-52. 13p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society Meeting, Washington, D. C.

The cross sections for the elastic and inelastic scattering of neutrons with an energy of about 2.5 Mev from even-even vibrational nuclei with low-lying 2+ states were calculated using the shell model with residual pairing and quadrupole forces. The interaction between the scattering neutron and the target nucleons was represented by a two-body, central, nonexchange potential with a Yukawa shape. The results for ^{52}Cr, ^{56}Fe, and ^{48}Ti were compared with experimental data. (D.C.W.)

24339 (COO-720-060) MUON CAPTURE AND SUPERMULTIPLET SYMMETRY BREAKING IN ^{16}O. Technical Report No. 60. Walker, George Edward (Case Inst. of Tech., Cleveland, Ohio. Nuclear Physics Lab.). June 1966. Contract AT(11-1)-720). 186p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

The validity of assuming the equality of the unretarded dipole muon capture matrix elements, $(M_v^1)_{U,D}$, $(M_p^2)_{U,D}$, and $(M_a^2)_{U,D}$ is investigated for muon capture in ^{16}O. Earlier investigations employed supermultiplet theory to obtain $(M_v^2)_{U,D} = (M_p^2)_{U,D} = (M_a^2)_{U,D}$; therefore, the correctness is considered of a supermultiplet grouping of important muon capture nuclear final states as realistic supermultiplet symmetry breaking interactions are included in the nuclear Hamiltonian. The basic wave functions are taken to be simple shell model L-S coupled states belonging to the $(1p)^{-1}2s$ and $(1p)^{-1}1d$ configurations of ^{16}O. Energy eigenvalues and eigenfunctions of various nuclear hamiltonians are obtained by evaluating the residual interaction matrices that mix the simple basic states. The results indicate that the spin-independent interparticle forces isolate the unretarded dipole muon capture strength in the supermultiplet lying highest in energy. The energy difference between this supermultiplet and lower-lying supermultiplets precludes the large amount of supermultiplet mixing one might expect when tensor and spin-orbit forces are added to the hamiltonian. Therefore, it is found that the muon capture strength remains concentrated in the giant dipole region and that the muon capture supermultiplet remains substantially pure. In all cases, $(M_v^2)_{U,D} = (M_p^2)_{U,D} = (M_a^2)_{U,D}$ remains a valid assumption to within twelve percent. (auth)

24340 (GA-5816) GACA, A FORTRAN IV CODE FOR CAPTURE AREA ANALYSIS OF LOW-ENERGY NEUTRON RESONANCES. Froehner, F. H.; Huffman, D. L.; Haddad, E.; Lopez, W. M. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Feb. 15, 1965. Contract AT(04-3)-167. 54p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

The program can be used for the determination of resonance parameters from neutron capture data by area analysis. One can calculate points of the Γ_n versus Γ_γ curve defined by a measured counting-rate sum ("area") under a resonance peak and by a given spin factor. Multiple scattering and instrumental resolution are accounted for. Wing corrections can be made for up to six neighbor resonances. (M.O.W.)

24341 (IDO-17107(Suppl.1)) EFFECTIVE CROSS-SECTION FACTORS. Nisle, R. G. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Mar. 1966. Contract AT(10-1)-205. 15p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

This supplement consists of tabulations for additional isotopes not included in the original report and of corrections where errors were detected. Data sources, calculation methods, and nature of the corrections are given for each of the tables. (M.O.W.)

24342 (JINR-E-2580) DIFFRACTION EFFECTS IN THE PROTON TRANSFER REACTIONS. Wilczynski, J.; Volkov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1966. 20p. Dep. mn.

A study of the transfer reactions with heavy ions was undertaken to provide information concerning the diffraction effects in these reactions. The proton pickup reactions ^{27}Al(^{12}C,^{18}N)^{26}Mg and ^{12}C(^{12}C,^{18}N)^{11}B were investigated. Angular distributions of the ^{18}N reaction products were measured with a good angular resolution at different energies of ^{12}C ions. The data on the energy distributions of ^{18}N products were also obtained. The angular distributions exhibit diffraction oscillations which damp out as incident energy decreases. The experimental data are compared with predictions of the Frahn and Venter diffraction model and with the theoretical results of Gareyev, Grabowski, and Kalinkin. (auth)

24343 (LA-DC-7603) ELASTIC AND INELASTIC SCATTERING OF FAST NEUTRONS FROM ^{6}Li AND ^{7}Li. Hopkins, John C. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1966]. Contract W-7405-eng-36. 22p. (CONF-660303-21). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The differential elastic and inelastic neutron scattering cross sections of ^{6}Li and ^{7}Li were measured at six scattering angles with an incident neutron energy of 4.83 Mev for ^{6}Li, and with energies of 3.35 and 4.83 Mev for ^{7}Li. Scattered neutrons and gamma rays were observed independently. The neutron cross sections were measured with a neutron time-of-flight spectrometer relative to the well-known cross section for neutron scattering from hydrogen. The gamma-ray spectra were measured with a NaI(Tl) spectrometer, using time-of-flight techniques to eliminate the neutron background. The 2.184-Mev state in ^{6}Li was excited by neutron inelastic scattering and was observed not to decay by gamma-ray emission. Scattered neutrons from the 0.478-Mev state in ^{7}Li were resolved at both incident neutron energies. A continuum of neutrons due to three particle breakup was observed from both ^{6}Li and ^{7}Li at 4.83 Mev. (auth)

24344 (LA-DC-7612) GAMMA-RAY PRODUCTION CROSS SECTIONS OF FAST NEUTRON-INDUCED REACTIONS IN Al, Fe, Nb, W, U, AND Pu. Conde, Henri; Drake, Darrell M.; Hopkins, John C. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 11p. (CONF-660303-18). ORAU.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

Differential cross sections for gamma production by fast neutrons are being measured for Al, Fe, Nb, W, ^{235}U, and ^{239}Pu with neutrons in the energy range from 3.5 to 7.5 Mev. Use is made of a NaI(Tl) spectrometer surrounded by a large NaI(Tl) anticoincidence shield. The efficiency and the energy resolution of the spectrometer were determined with calibrated gamma sources. The resolution of the 0.66-Mev gamma rays from ^{137}Cs is about 9%. Gamma rays between 100 kev and 7 Mev are detected. Nanosecond time-of-flight techniques are used to eliminate the neutron background. An on-line computer, employed as a two-dimensional pulse-height analyzer, records and displays time versus energy. The time resolution of the gamma rays without correction for rise time effects is about 3 nsec. Preliminary results for the relative cross sections are given for Al. (auth)

24345 (LA-DC-7613) MEASUREMENTS ON THE CAPTURE CROSS-SECTION OF ^{238}U WITH BOMB SOURCE NEUTRONS. Glass, N. W.; Theobald, J. K.; Schelberg, A. D.; Warren, J. H.; Tatro, L. D. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract W-7405-eng-36. 11p. (CONF-660303-20). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

Measurements of the neutron capture cross-section of ^{238}U by neutron time-of-flight utilizing the pulse source of neutrons from a nuclear device were made on the Parrot and Petrel underground shots at the Nevada Test Site. The

neutron flight path was approximately 200 meters. Three ^{238}U samples of 200, 200, and 16.6 barns/atom, respectively, were in the beam and viewed by a variety of Moxon-Rae type photomultiplier and solid-state detectors, resulting in a self-indication type of measurement from which resonance parameters can be derived for resonances from 36.7 to ~2000 ev. Experimental details, data recording techniques, and results are described. (auth)

24346 (LA-DC-7617) RELATIVE FISSION CROSS SECTIONS OF ^{238}U, ^{237}Np, AND ^{235}U. Stein, W. E.; Smith, R. K.; Grundl, J. A. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1966]. Contract W-7405-eng-36. 18p. (CONF-660303-24). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

Fission cross-section ratios $^{238}U/^{235}U$ and $^{237}Np/^{235}U$ were measured with pulsed, monoenergetic neutrons in the energy range 1.0 to 5.0 Mev with time-of-flight background discrimination. Vacuum evaporated fissile deposits (~0.5 mg/cm^2) were placed back to back between two 9.5 cm^2 surface barrier detectors. Slow and fast output signals were obtained simultaneously from each detector by means of separate electronic systems. Slow, linear pulses which exceeded a lower bound set to reject alpha particles were identified as fission events. The fraction of fragment pulses below this bias, determined from an extrapolation of the pulse-height spectrum, was ~1.2%. Only those fission events which occurred during and a few nanoseconds after the neutron burst were recorded. This time interval, determined by the measured time resolution (1.3 nsec FWHM) and the time walk of the smallest pulses (~2 nsec), was typically 10 nsec. Fission events induced by scattered neutrons which occur at later times were excluded. Characteristics of this detector and electronic system are presented along with the measured cross section ratios. (auth)

24347 (LA-DC-7618) FISSION CROSS SECTION OF ^{235}U, 20 ev–2 Mev. Brown, Wilbur K.; Bergen, D. W.; Cramer, J. D. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1966]. Contract W-7405-eng-36. 14p. (CONF-660303-25). ORAU.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The fission cross section of ^{235}U was measured by time-of-flight techniques using neutrons generated by an underground nuclear explosion. In the Petrel event in June 1965, at the Nevada Test Site, a moderator was placed in the 200-m flight path directly above the source. A high-intensity flux was obtained from 20 ev to 2 Mev, and the fission cross sections of several isotopes including ^{233}U, ^{235}U, and ^{239}Pu were measured relative to each other. The $^{6}Li(n,\alpha)T$ reaction was used to measure the energy-dependent flux up to about 100 kev; and from 10 kev to 2 Mev, the $^{235}U(n,f)$ reaction was used for this purpose. Cross sections of other isotopes were determined using this flux, and a comparison of all these cross sections with available data served to anchor the matrix. Data are presented which exhibit good resolution in the resonance region with lower backgrounds than previous measurements. The peak-to-valley ratios agree with Harwell measurements. The absolute values are in excellent agreement with the data of Bowman at low energies. (auth)

24348 (LA-DC-7620) FISSION CROSS SECTION OF ^{239}Pu, 20 ev to 2 Mev. Shunk, Edward R.; Brown, W. K.; LaBauve, R. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1966]. Contract W-7405-eng-36. 16p. (CONF-660303-22). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The fission cross section of ^{239}Pu was measured by time-of-flight using neutrons from an underground nuclear explosion. The Petrel event in June 1965, at the Nevada Test Site provided an extremely high neutron flux from 20 ev to 2 Mev. The neutron flux was determined from simultaneous measurement of $^{6}Li(n,\alpha)$ for E < 100 kev, and $^{235}U(n,f)$ for E > 10 kev. Backgrounds were measured by recording signals from blank backing foils. (auth)

24349 (LA-DC-7622) THE FISSION CROSS SECTION OF ^{233}U, 20 ev TO 2 Mev. Bergen, D. W.; Silbert, M. G.; Perisho, R. C. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1966]. Contract W-7405-eng-36. 13p. (CONF-660303-16). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

Data are presented on the fission cross section of ^{233}U over the energy range from 20 ev to 2 Mev. These data were obtained in June 1965 by exposing a thin target of ^{233}U to neutrons originating from an underground nuclear detonation. The data show resolved individual resonances from 20 ev to about 100 ev and resonance structure to above 1 kev. The low background and good energy resolution inherent in this experiment provide an improved peak-to-valley ratio compared to previously reported data. (auth)

24350 (LA-DC-7774) CROSS SECTIONS FOR NUCLEOSYNTHESIS IN STARS AND BOMBS. Bell, George I. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1966]. Contract W-7405-eng-36. 23p. (CONF-660303-15). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

Three different processes are considered in which nuclei are synthesized by the multiple capture of neutrons with energies in the kev range, namely the s-process and r-process in stars, and the synthesis of very heavy nuclei in thermonuclear explosions. It is shown how the knowledge of neutron capture cross sections for s-process nuclei can clarify such features of the s-process as elemental abundances, time scales, and temperatures. For heavy element synthesis, more data are needed on capture to fission ratios, particularly for odd-odd nuclei. (auth)

24351 (MIT-905-52, pp 1-41) NUCLEAR CHEMISTRY GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Results of nuclear decay-scheme studies, nuclear fission studies, and nuclear-reaction studies are presented. Research on physico-chemical systems is reported, and studies of earth sciences, instrumentation, and data handling are summarized. (J.R.D.)

24352 (MIT-2098-149) CORRELATION ENHANCEMENT OF COMPOUND ELASTIC SCATTERING AND DOORWAY STATE REACTIONS. Moldauer, P. A. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science. Argonne National Lab., Ill.). May 27, 1965. Contract AT(30-1)-2098. 9p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The effects of width correlations on the energy averages of fluctuating cross sections were earlier discussed with respect to compound elastic scattering. It is pointed out that such correlations may also produce a substantial enhancement of average non-elastic reaction cross sections. A quantitative discussion is given of the correlation enhancement of both compound elastic and doorway state reaction cross sections. (M.O.W.)

24353 (N-66-15632(Paper 2)) COMPUTER PROGRAM FOR ANALYSIS OF BETA-RAY SPECTRA MEASURED WITH SOLID-STATE DETECTORS. (Western Reserve Univ., Cleveland, Ohio). 22p. (N-66-15634).

A Fortran IV program used for analyses of beta spectra measured with lithium-drifted surface-barrier silicon detectors is described. This program contains the following subdivisions: fitting of the measured spectrum with a polynomial; an iteration procedure using the measured response function of the detector to obtain the undistorted spectrum from the measured spectrum; and computation of the Fermi-Curie plot using the shape correction factor and determination of the endpoint energy by least squares fitting. (STAR)

24354 (ORNL-P-2026) DIFFERENTIAL ELASTIC SCATTERING OF NEUTRONS FROM NITROGEN. Fowler, J. L.; Johnson, C. H.; Kernell, R. L. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 14p. (CONF-660303-4). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

Differential cross sections were measured at energies between 1.595 and 3.207 Mev. A detailed discussion of the results is presented. (M.O.W.)

24355 (RPI-328-50) FUTURE TRENDS IN CROSS SECTION WORK WITH ELECTRON LINACS. Rae, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science). [1966]. Contract AT (30-3)-328. 22p. (CONF-660303-5). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The present status of neutron time of flight spectroscopy using electron linacs as pulsed neutron sources is summarized. Probable lines of development over the next few years are discussed. Pulsed sources and instrumentation, including electronics and data handling methods, are discussed. Experimental methods, new and improved detection techniques, extension of existing techniques to a wider energy range and greater accuracy, and the probable result of these improvements in terms of nuclear data are discussed. (auth)

24356 (RPI-328-51) Mev TOTAL CROSS SECTIONS WITH THE RENSSELAER LINAC. Yergin, P. F.; Martin, R. C.; Winhold, E. J.; Medicus, H. A.; Moyer, W. R.; Augustson, R. H.; Kaushal, N. N.; Fullwood, R. R. (Rensselaer Polytechnic Inst., Troy, N. Y.). [1965]. Contract AT(30-3)-328. 17p. (CONF-660303-7). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

The Rensselaer electron linac was used to measure Mev neutron total cross sections of a number of nuclides. Bursts of 90 Mev electrons of <10 nsec duration on a composite B_4C and W target produce a broad neutron spectrum which is analyzed by time-of-flight. The analysis system includes a 100-meter flight path (with 250 meters to be completed in early 1966), a 20″-diameter liquid scintillator neutron detector coupled to tunnel-diode electronics, a time-to-pulse-height converter, and multichannel pulse-height recording. Collimation diameters of 3″, 2″, and 0.22″ were used. With the smallest diameter, separated isotope samples can be used. Overall time resolution is now about 0.25 nsec/m, and will soon be reduced to 0.05 nsec/m or better. The high intensity of the linac beam permits rapid data accumulation even with the smallest collimator. Typically, 3% statistics can be obtained at each of 2000 data points from a total of 3 hours running time. Average neutron detection rates of one per linac beam burst are used, with an accurate counting-loss correction procedure to correct for the loss of as much as 60% of the counts in the late channels. Useful data are obtained from 0.4 to 45 Mev. (auth)

24357 (UCRL-14538) PHYSICS DEPARTMENT PROGRESS REPORT, JUNE-SEPTEMBER 1965. (Lawrence Radiation Lab., Univ. of California, Livermore). Contract W-7405-eng-48. 82p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Various experimental and theoretical research carried out in the field of atomic and nuclear physics, thermodynamic properties of matter, fluid and hydrodynamics, and radiation physics is reported. Brief summaries of research on each of the above are presented. (M.O.W.)

24358 (UCRL-16580, pp 1-93) RADIOACTIVITY AND NUCLEAR STRUCTURE. (Lawrence Radiation Lab., Univ. of California, Berkeley).

Research progress is reported on excited-state g-factor measurements, ^{99}Ru 90-kev g factors; ^{100}Rh g factors and half-life; ^{110}Ag nuclear spin and moment; ^{239}Pu magnetic moment; ^{148}Pm and ^{165}Er hyperfine structure and nuclear moments; ^{254}Es decay scheme; ^{239}Am and ^{241}Am energy levels; ^{246}Cm odd-parity rotational bands; wave functions for nuclear pairing-force problems; threshold pair production cross sections; lifetime of ^{90}Nb 24-sec isomer, ^{88}Y beta transition; isomeric states of ^{180}W, ^{182}Os, and ^{184}Pt; ^{183}Re isomer $25/2^+$; gamma angular distribution in ^{139}La proton reactions; ^{8}Be spin and parity at 16.6 and 16.9 Mev; ^{12}C, ^{14}N, and ^{16}O (d,α) reactions at 24 Mev; energy spectra from (α,d) reactions; ^{18}O energy levels; levels in ^{20}Na and ^{18}F using (^{3}He-t) reactions; T = 3/2 levels in ^{7}Li, ^{7}Be, ^{7}He, ^{7}B, and ^{8}He; characterization of ^{4}He and ^{4}Li; ^{3}He and ^{4}He scattering on ^{11}B; ^{12}C(d,t)^{11}C and ^{12}C(d,^{3}He)^{11}Be reactions; α scattering by ^{52}Cr; α-decay recoils from ^{226}Th; T = 3/2 states in ^{13}C, ^{13}N, and ^{13}O; neutron-deficient isotopes of Rn; ^{86}Zr decay; ^{212}Po shell-model calculations; ^{212}Fr α decay; ^{88}Nb radiations; ^{89}Nb radiations; ^{237}U decay; and ^{87}Y and ^{87}Sr M4 transitions. (J.R.D.)

24359 (UCRL-16580, pp 95-106) FISSION. (Lawrence Radiation Lab., Univ. of California, Berkeley).

Research progress is reported on identification of heavy-ion reaction products; ^{252}Cf primary fission products; fission fragment angular distribution from ^{209}Bi and ^{238}U; fission properties of elements below Ra; and fission of ^{238}U by ^{40}Ar. (J.R.D.)

24360 (UCRL-16580, pp 107-48) NUCLEAR REACTIONS AND SCATTERING. (Lawrence Radiation Lab., Univ. of California, Berkeley).

Research progress is reported on analysis of (p,t) reactions; theory and descriptions of scattering reactions; ^{4}He(p,d)^{3}He reactions with polarized protons; determination of proton-proton $^{1}S_0$ shape parameter; alpha scattering on ^{58}Fe; ^{40}Ca scattering of ^{3}He and ^{4}He; deuteron cross sections; charge effects on proton-proton scattering; and ^{6}Li and ^{7}Li proton reactions. (J.R.D.)

24361 (WANL-TME-1384) PREPARATION OF MICROSCOPIC CROSS SECTIONS OF ^{235}U FOR REACTOR CALCULATIONS. Drawbaugh, D. W.; Gibson, Gordon; Melnick, M. M. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Feb. 28, 1966. Contract SNP-1. 41p. (CONF-660303-13). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

A set of resonance parameters for the epithermal range is given. The origin of these parameters is described. Of importance for reactor calculations is a table which gives the smooth (temperature independent) background cross sections which must be added in order to bring the single-level theoretical cross sections into agreement with experiment. The Saclay experimental data were used; the corresponding Doppler broadening and experimental resolution were taken into account in the calculations. This representation for the cross sections is of value for calculations concerning nuclear rocket reactors (NERVA) which operate at high temperatures, and for which a large fraction of the fissions are induced by epithermal neutrons. (auth)

24362 (ANL-Trans-294) EXPERIMENTAL ESTIMATES OF ELECTRIC POLARIZABILITY COEFFICIENTS OF NUCLEONS. Aleksandrov, Yu. A.; Samosvat, G. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report JINR-P-2495. 21p. Dep. mn. CFSTI $1.00 cy, $0.50 mn; JCL $2.60 fs, $0.83 mf.

Recent papers are reviewed which are concerned with experimental estimates of the magnitude of the electric polarizability coefficient for the neutron-photon scattering by deuterons, small-angle neutron scattering, kv neutron scattering by heavy nuclei. (auth)

24363 (CEA-tr-A-1845) L'EMPLOI DU SPECTRE DE FISSION POUR LE CALCUL DES SECTIONS EFFICACES EFFECTIVES DE DETECTEURS A VALEUR DE SEUIL DANS LES REACTEURS MODERES A L'EAU OR-

DINAIRE. (The Use of Fission Spectra for Calculation of Effective Cross Sections of Detectors at Threshold Value in H_2O-Moderated Reactors). Diettrich, H. O. W. (Physikalisch-Technische Bundesanstalt, Brunswick (West Germany)). Translated into French from report PTB-VI-C/N-3. Oct. 1964. 11p. Dep. mn. JCL $1.60 fs, $0.80 mf.

The use of fission spectra in the calculation of the effective cross sections of threshold detectors was analyzed by two methods. (J.S.R.)

24364 DECAY OF ^{91}Mo AND ^{91m}Mo. Cretzu, T.; Hohmuth, K.; Schintlmeister, J. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Ann. Phys. (7), 16: 312-18(1965). (In German).

The γ-radiation emitted in the decay on ^{91}Mo and ^{91m}Mo was investigated using a scintillation spectrometer and a two-dimensional coincidence apparatus. Three new γ-lines with energies 800, 1040, and 1600 kev, which are coincident with the 511-kev annihilation, can be attributed to the decay of ^{91}Mo. The half life of ^{91}Mo was found to be 15.7 ± 0.2 min. The investigation of the decay of ^{91m}Mo gave the already known γ-spectra. The relative intensities of the γ-lines were determined. $T_{\frac{1}{2}}$ = (68 ± 2) sec was found for ^{91m}Mo. The experimental level scheme of ^{91}Nb was compared with theory. (tr-auth)

24365 ELASTIC SCATTERING OF HIGH-ENERGY ELECTRONS BY NUCLEI. Mukherjee, Sailajananda; Majumdar, S. Datta (Univ. Coll. of Science, Calcutta. Indian Inst. of Tech., Kharagpur, India). Ann. Phys. (7), 16: 360-9(1965).

Dirac's equation for the scattering of high energy electrons by a modified Coulomb potential is solved approximately after converting it into a second order equation, and a closed expression for the scattering amplitude is obtained. The expression can be used to obtain information about the charge distribution in the nuclei by analyzing the experimental data on electron scattering. To test the usefulness of the approach some preliminary calculations were done on Au and C nuclei, and the results are found to be satisfactory. (auth)

24366 CONTRIBUTION TO THE STUDY OF REACTIONS INDUCED BY A LOW-ENERGY ^{3}He BEAM ON A ^{12}C TARGET. Schapira, J.-P. (Laboratoire Joliot-Curie, Orsay, France). Ann. Phys. (Paris) (13), 10: 743-90(Nov.-Dec. 1965). (In French).

Results of the study of reactions induced by a ^{3}He beam on a carbon target showed that at low energies between 4 and 6 Mev the phenomenon of compound nucleus formation was predominant. The presence at 15 and at 165° of resonances in the reaction $^{12}C(He_3,\alpha_0)^{11}C$ was shown. At these angles the effects of direct interaction are generally important: pickup of a neutron of ^{12}C in the 1p shell leading to a maximum in a forward direction and the stripping of a preformed α particle in the target nucleus, emitted preferentially in the backward direction. This last process has a certain importance because of the 3-α structure of the ground state of ^{12}C. Nevertheless these effects of direct interaction do not vary rapidly with the incident energy, aside from the eventual resonances due to optical model in the input and output paths. These resonances are much larger than those observed in the forward direction and in the backward direction in the cross section $^{12}C(He_3,\alpha_0)^{11}C$, which is attributed to the formation mechanism of the compound nucleus. It was shown that the analysis of the elastic scattering results with the theory of resonances leads, in the case of strongly absorbed incident particles, to the problem of the inversion of the matrix $1-R^{\circ}L^{\circ}$. This difficulty was overcome by expressing the effect of remote levels by the complex dephasing of the optical model. It was seen that the first resonance at 5 Mev was due to a $\underline{1} = 4$ wave in the input path but the results for the second level were less satisfactory. Although the electric angular distributions do not premit a distinction between the two possible spins of the state of the compound nucleus, the analysis using Legendre polynominals of the results of $^{12}C(He_3,\alpha_0)^{11}C$ made it possible to select the values $^9/_2+$ and $^{11}/_2-$ with probability as the spin of the states at 16.07 and 16.63 Mev of ^{15}O. At this excitation numerous configurations of ^{15}O can possess very high spins. No confrontation appears possible at the moment with a theory explaining the various excited levels of ^{15}O. In particular, the obtention of reduced lengths in ^{3}He and in α, which can give eventually some indications on the configurations concerned, is random because of the approximations used in the theory of the $-R$ matrix are not applicable in this case. There is a disagreement between the elastic scattering around the resonance at 5.7 Mev. (tr-auth)

24367 FORMATION OF THE ISOTOPES OF LITHIUM, BERYLLIUM, AND BORON BY THE INTERACTION OF MEDIUM-ENERGY PROTONS WITH ^{12}C AND ^{16}O. APPLICATION TO THE NUCLEOGENESIS OF LIGHT ELEMENTS. Gradsztajn, Elie (Laboratoire Joliot-Curie, Orsay, France). Ann. Phys. (Paris) (13), 10: 791-825(Nov.-Dec. 1965). (In French).

The experimental method used to determine the cross sections of the stable isotopes of lithium by mass spectrometry are described and it is shown how the problems posed by the analysis of quantities of the order of 10^{-15} to 10^{-14} g of lithium are resolved. The cross sections for the reaction ^{12}C + p was calculated at 156 Mev. By the methods described the cross sections of the reactions $^{12}C + p$ and $^{16}O + p \rightarrow {}^6Li$ and ^{7}Li were determined for protons with energy between 44 and 550 Mev. The results for ^{12}C were interpreted on the basis of the two-step model of Serber. In the first step, the internuclear cascades were calculated according to the Goldberger model by the Monte Carlo method. The calculation included the possibility of elastic scattering of the nucleons on the α structure at the interior of the nucleus. In the second step, the problem of the de-excitation of the residual nuclei was treated by a process different from that of the evaporation generally applied to heavy nuclei. The agreement between the values calculated for the cross sections of the reactions leading to ^{6}He, ^{6}Li, ^{7}Li, ^{8}Li, and ^{10}Be with the experimental values was satisfactory. It appeared that the second step should be conceived under a new form although this implies abandoning the Serber model. The preceeding results concerning the rate of production of ^{6}Li, ^{7}Li, ^{9}Be, ^{10}B, and ^{11}B made it possible to re-examine the present theories on the nucleosynthesis of the light elements during the formation of the solar system. On the basis of the new data, a scheme was proposed that is different from that of Fowler, Greenstein, and Hoyle. (tr-auth)

24368 EFFECTS OF POLARIZATION IN NON-RELATIVISTIC NUCLEAR REACTIONS. Bergdolt, Georges (Centre de Recherches Nucleaires, Strasbourg). Ann. Phys. (Paris) (13), 10: 857-80(Nov.-Dec. 1965). (In French).

The problem of the calculation of experimental results as a function of the elements of the scattering matrix is considered theoretically. The phase shifts for the elastic scatterings $^{12}C(p,p)^{12}C$ and $^{16}O(p,p)^{16}O$ were obtained by analyzing the measurements of the cross sections. From a knowledge of the phase shift the polarization of the scattered particles can be calculated. The measurements of polarization make it possible to verify and define the phase-shift analysis. The experimental technique used in the measurement of the double-scattering polarization and the results obtained are reported. (J.S.R.)

24369 A NOTE ON THE DETERMINATION OF THE STRUCTURE OF THE Th(B + C)A-LINE. Sevier, K. D. (Uppsala Univ.). Ark. Fys., 28: 397-8(1965).

The structure of the thorium (B + C) A line was studied. This line, which is a composite of the 39.85-L_I line in ^{208}Tl following the alpha decay of ^{212}Bi and the 115.1-K line in ^{212}Bi following the beta decay of ^{212}Po, was investigated to determine the intensity ratio for the contribution of the 39.85-L_I L line due to the decay of atoms originating on

the back side of the source to that due to the decay of atoms originating on the front side. The results are plotted, and the intensity ratio $I(115.1\text{-}K)/I(115.1\text{-}K + 39.85\text{-}L_I) = 17.4 \pm 2.3\%$ is given. (J.F.P.)

24370 A DECAY OF ^{189}Re TO ^{189}Os. Blichert-Toft, P. H. (Chalmers Univ. of Tech., Goteburg). Ark. Fys., 28: 415-26(1965).

The decay of ^{189}Re to ^{189}Os was investigated by means of a double focusing beta-ray spectrometer, an intermediate image beta-ray spectrometer and several gamma-ray spectrometers. The activity was produced by an (α,p) reaction on isotope-separated ^{186}W in a cyclotron. Beta-ray, gamma-ray, and internal conversion spectra were measured. The end point energy of the beta-ray group populating the ground state level in ^{189}Os was determined as 1015 ± 20 kev. The result obtained for the half life of ^{189}Re is 24.3 ± 0.4 hours. Thirteen electromagnetic transitions in the ^{189}Os daughter were measured with high precision. A decay scheme is proposed on the basis of the energy data. Evidence has been found for a ^{189}Re isomer with a half life of 140 ± 20 days decaying to 779 and 882 kev levels in ^{189}Os. Half life measurements have been made on the two long-lived rhenium isotopes of mass number 183 and 184 over a period of one and a half years. The result obtained for the half life of ^{183}Re is 71 ± 2 days and ^{184}Re reveals two isomers with half lives which have been determined as 34 ± 5 days and 166 ± 12 days, respectively. (auth)

24371 INFLUENCE OF NONCOINCIDENCE OF THE CENTERS OF MASS AND CHARGE OF THE DEUTERON ON ITS PENETRATION THROUGH THE COULOMB POTENTIAL BARRIER. Kraev, M. Compt. Rend. Acad. Bulg. Sci., 18: 895-8(1965). (In Russian).

The Coulomb field acts not at the center of mass of the deuteron, but at the proton. Consideration of this asymmetric effect of the Coulomb field on the deuteron leads to increase of its coefficient of penetration through a Coulomb potential barrier. (tr-auth)

24372 POLARIZATION AND CORRELATION PHENOMENA IN NUCLEAR REACTIONS. Hehl, K. (Zentralinstitut fuer Kernforschung, Deutsche Akademie der Wissenschaften zu Berlin, Rossendorf, Ger.). Fortschr. Phys., 13: 557-97(1965). (In German).

Within the framework of a lecture series with the purpose of explaining the theoretical picture of orientation effects and representing clearly the most important mathematical and theoretical concepts, a lecture was given on the correlation and polarization phenomena in nuclear reactions. The orientative state was described and the orientation phenomena appearing in nuclear reactions were discussed. The polarization and correlation phenomena in deuteron stripping was then considered. Correlation functions for decay processes were given. (J.S.R.)

24373 NUCLEAR REACTIONS ON ^{12}C AT THE INCIDENT PROTON ENERGY OF 54.9 Mev. Muto, Jiro (Kyoto Univ.); Yamaguchi, Hisashi. Genshikaku Kenkyu, 10: 488-505(Dec. 1965). (In Japanese).

A number of differential cross sections of (p,p), (p,p′), (p,d), and (p,t) reactions on ^{12}C at an incident proton energy of 54.9 Mev are presented. Momentum analysis of the reaction products was performed with a magnetic-analyzer system operated with energy resolution of about 0.6%. For (p,p′) reactions, angular distributions were obtained for the five prominent proton groups corresponding to the excitation energies of 4.43, 7.66, 9.64, 12.71, and 15.11 Mev in ^{12}C. For (p,d) reactions, angular distributions were obtained for the six prominent deuteron groups corresponding to the ground (1 = 1), first (1.99 Mev, 1 = 1), second (4.38 Mev, 1 = 3), third (4.82 Mev, 1 = 1) fourth plus fifth (6.34 and 6.48 Mev) and sixth (6.90 Mev, 1 = 3) states in ^{11}C. Assigned 1−values obtained by fitting the Butler curves to the experimental angular distributions are indicated in the parentheses. For (p,t) reactions, angular distributions were obtained for the two prominent triton groups corresponding to the ground (1 = 0) and first (3.34 Mev, 1 = 2) excited states in ^{10}C. He^3 and alpha spectra from (p,^{3}He) and (p,α) reactions were taken only at two angles (40° and 90°). Those data are analyzed and discussed qualitatively. (auth)

24374 PROCESS ^{8}Be → 2 ^{4}He IN NUCLEAR EVAPORATION. Metzger, C.; Daetwyler, J.; Boskovic, B.; Jeannet, E. (Univ., Neuchatel, Switzerland). Helv. Phys. Acta, 39: 58-64(1966). (In French).

Emission of ^{8}Be nuclei was identified in stars produced by 400 Mev neutrons in Cu, Ag, and Pt foils sandwiched between nuclear emulsions, and in stars formed by 600 Mev protons in Ag and Br in nuclear emulsions. The ^{8}Be nucleus was identified from its two decay products by using the invariant mass method. This emission is discussed in the framework of the evaporation theory. It is seen that the mean measured energy of the alpha's produced in ^{8}Be decay is smaller than the mean energy of evaporated alpha's and that the production rate is greater than that which is predicted by the evaporation theory. Arguments are put forward concluding that ^{8}Be is emitted before or at the beginning of the evaporation process. (auth)

24375 ASYMMETRY OF NEUTRONS FROM (μ^-,n) REACTIONS WITH NUCLEI OF DIFFERENT SPINS FOLLOWING ABSORPTION OF NEGATIVE COSMIC-RAY MUONS. Bobodzhanov, I. B.; Ivanenko, V. M.; Kashkarov, L. L.; Cherdyntsev, V. V. (Physicotechnical Inst., Academy of Sciences, Tadzhik SSR. Tadzhik State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1772-3(Sept. 1965). (In Russian).

The anisotropy of neutrons emitted by Pb, Bi, Cu, and Fe targets under 10^3 g/cm^2 of earth at Pamir (3860 m above sea level) consequent to absorption of negative cosmic muons was determined. Anisotropy of the emitted neutrons is due entirely to the polarization retained by the muons after absorption into K orbits. It was anticipated that the depolarization on absorption in the Bi and Cu (spins $^9/_2$ and $^3/_2$) targets would be greater than that on absorption in the Pb and Fe (spin 0) targets, owing to spin-spin interaction. No neutron anisotropy greater than the experimental error was observed with the Bi and Cu targets, and definite and approximately equal anisotropies were observed with the Pb and Fe targets. It is concluded that the depolarization of negative muons on absorption in Pb and Fe is about two times less than predicted and that negative muons are practically completely depolarized on absorption in Bi and Cu. (ATD)

24376 NEUTRON-DEFICIENT SILVER AND CADMIUM ISOTOPES. Butement, F. D. S.; Mirza, M. Y. (The University, Liverpool). J. Inorg. Nucl. Chem., 28: 303-11 (Feb. 1966).

Two radioisotopes, ^{100}Ag (9 min β^+ 5.8 Mev) and ^{101}Ag (14 min) were produced by spallation reactions of silver and cadmium with 340-Mev protons. ^{102}Ag was found to have a half life of 13.5 min and to emit 3.7-Mev positrons. Gamma radiation from ^{104m}Ag is reported. Spallation of cadmium gave the radioisotopes ^{101}Cd (15 min) and ^{102}Cd (30 min). (auth)

24377 MEASUREMENT OF $\bar{\nu}$ FOR NEUTRON-INDUCED FISSION OF ^{240}Pu. de Vroey, M.; Ferguson, A. T. G.; Starfelt, N. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Energy, Pt. A/B, 20: 191-200 (Mar. 1966).

Measurements were made of $\bar{\nu}$, the number of prompt neutrons per fission, following neutron-induced fission of ^{240}Pu. The measurements were made using a pulsed source of monoenergetic neutrons. The ^{240}Pu was contained in a fission ion chamber placed close to the neutron source, and the neutrons detected in a 10 cm diameter plastic scintillator 60 cm from the fission chamber. A number of geometries were investigated experimentally verifying calculated corrections for neutron-fragment correlations, effect of finite foil thickness, and presence of ^{239}Pu and ^{241}Pu. Values of $\bar{\nu}$ obtained for neutron energies of 0.1 Mev and 1.6 Mev were 2.89 ± 0.19 and 3.26 ± 0.12 respectively. (auth)

24378 RADIATIVE CAPTURE CROSS SECTION OF GOLD AT THE ENERGY OF Sb–Be PHOTONEUTRONS.

Ryves, T. B.; Robertson, J. C.; Axton, E. J.; Goodier, I.; Williams, A. (National Physical Lab., Teddington, Eng.). J. Nucl. Energy, Pt. A/B, 20: 249-60(Apr. 1966).

The $^{197}Au(n,\gamma)^{198}Au$ reaction was studied using a calibrated Sb–Be photoneutron source. The ^{198}Au activity produced in the reaction was determined by an absolute counting technique. A value of 640 ± 25 mb for the cross section was obtained, at the assumed neutron energy of 24.8 kev. (auth)

24379 THE FUNDAMENTAL ROTATIONAL BAND OF THE ^{171}Tm NUCLEUS. Bocquet, J. P. (Faculte des Sciences, Grenoble, France. CEN, Saclay, France). J. Phys. (Paris), 26: 795-8(Dec. 1965). (In French).

The gamma rays of the fundamental rotational band ($1/2$, $3/2$, $5/2$, $7/2$) in ^{171}Tm were investigated by the internal conversion process. Experimental data are in good agreement with the unified nuclear model and the electromagnetic transition probability parameters: b_0, g_R, $g_K - g_R$, and $g_{s\ eff.}$ were calculated. These parameters are not very different from the corresponding parameters in ^{169}Tm. (auth)

24380 APPLICATION OF SU(3) SYMMETRY TO MULTIPLE MESON PRODUCTION. Daibog, E. I. (Joint Inst. of Nuclear Research, Dubna, USSR). JETP Lett. (USSR)(Engl. Transl.), 3: 152-3(Mar. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 237-40(Mar. 15, 1966).

The ratio $(\bar{N}^0 + \bar{N}^{\eta 0})/(\bar{N}^+ + \bar{N}^-)$ where $\bar{N}^{\eta 0}$ is the average number of η_0 mesons is calculated with the aid of SU(3) symmetry. (B.G.D.)

24381 CENTRAL INTERNUCLEAR INTERACTION IN IRREDUCIBLE FORM. I. THE EXPRESSION OF CENTRAL FORCES. Petrauskas, A.; Vanagas, V. (Inst. of Physics and Mathematics, Academy of Sciences, Lithuanian SSR). Lietuvos Fiz. Rinkinys, Lietuvos TSR Mokslu Akad., Lietuvos TSR Aukstosios Mokyklos, 5: 215-24(1965). (In Russian).

The hamiltonian of the central internuclear interaction with exchange is transformed by means of the symmetric group operation to the irreducible form. Such a transformation enables a matrix of the hamiltonian to reduce to the submatrices and invariants of the symmetric group without concrete form of the orbital wave function of the nucleus. A short discussion of this matrix is outlined. The Clebsch–Gordan series necessary for the calculations and the table of reduction for lowest states of light nuclei are given. (auth)

24382 MUON CAPTURE IN COMPLEX NUCLEI. Foldy, Leslie L. (Case Inst. of Tech., Cleveland). pp 5-25 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

Some calculations of meson (μ) capture in nuclei, particularly ^{40}Ca, ^{12}C, ^{4}He, and ^{16}O, are discussed. The nuclear matrix elements that are involved in the transition are considered in detail. (D.C.W.)

24383 VANISHING OF GIANT RESONANCES INTO THE COMPOUND-ELASTIC CHANNEL. McVoy, Kirk W. (Univ. of Wisconsin, Madison). pp 50-62 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

The vanishing of giant resonances into the compound-elastic channel is discussed using the optical model. (G.O.Y.)

24384 NUCLEAR COEXISTENCE. Brown, G. E. (Princeton Univ., N. J.). pp 105-23 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

The existence in the same nucleus of levels that are partly collective and partly individualistic in nature is discussed on the basis of some calculations for ^{16}O, ^{17}O, ^{18}O, and ^{20}O. (D.C.W.)

24385 CAN ONE CALCULATE NUCLEAR DEFORMATIONS? Baranger, Michel (Carnegie Inst. of Tech., Pittsburgh). pp 124-57 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

An attempt to develop a method of calculating nuclear shapes and to relate it to information from other aspects of nuclear structure is summarized. The dynamics of deformations were studied as well as their static aspects; predictions were made about collective effects involving changes of shape. (D.C.W.)

24386 SHELL MODEL FOR SYSTEMS OF IDENTICAL NUCLEONS. Macfarlane, Malcolm H. (Argonne National Lab., Ill.). pp 158-200 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

The seniority quantum number is defined, and it is then shown that seniority eigenstates can be identified by an angular-momentum quantum number (quasi-spin). This relabelling leads to explicit expressions for the dependence of particle-numbers of all the matrix elements that are of interest in a shell-model calculation for systems of identical nucleons. The available evidence concerning the goodness of seniority is reviewed leading to a discussion of shell-model calculations for the Ni isotopes. Finally, various approximate methods inspired by the BCS theory of superconductivity are presented from the viewpoint of the seniority classification of states. (D.C.W.)

24387 GENERALIZED HARTREE-FOCK APPROXIMATION AND ITS POSSIBLE APPLICATION TO THE EXCITED ROTATIONAL SPECTRUM OF ^{16}O. Klein, Abraham; Dreizler, Reiner M. (Univ. of Pennsylvania, Philadelphia). pp 220-42 of 1965 Midwest Conference on Theoretical Physics. Columbus, Ohio, Ohio State University, 1965.

A derivation of the generalized Hartree-Fock approximation (GHFA) is presented using a hypothetical physical model. The application of the GHFA to the even-parity rotational states of ^{16}O is then discussed. (D.C.W.)

24388 p-^{3}H AND n-^{3}He FINAL-STATE INTERACTIONS IN d+^{3}H AND d+^{3}He REACTIONS. Yu, D. U. L.; Meyerhof, W. E. (Stanford Univ., Calif.). Contract AF 49(638)-1389. Nucl. Phys., 80: 481-99(1966).

A modified Born approximation calculation was made in order to explain high-energy proton spectra from the three-body breakup of the d + ^{3}He reaction and the high-energy neutron spectra from the three-body breakup of the d + ^{3}He reaction. The modification takes into account the p–^{3}He and n–^{3}He final-state interactions by means of the so-called factor d wave function method. Effects of the Pauli principle on the breakup reaction are also considered. Complex p + ^{3}H and n + ^{3}He phase shifts are used, which had been derived from a prior analysis of the ^{3}H(p,p), ^{3}H(p,n) and ^{3}He(n,n) reactions. The present analysis shows that the main features of the energy and (forward) angular distributions of the high-energy nucleons from the three-body breakup of the d + ^{3}He and d + ^{3}H reactions can be reproduced by a simple approximation. The final-state interactions in the ^{4}He system are consistent with experimental states in ^{4}He peaking near 20.1 and 22 Mev excitation energy. The former state was previously shown by Werntz to be 0^+. The latter state has negative parity. (auth)

24389 INTERNAL CONVERSION COEFFICIENTS FOR HIGH-ENERGY TRANSITIONS. Carroll, C. O. (Nuclear Chicago Corp., Des Plaines, Ill.); O'Connell, R. F. Nucl. Phys., 80: 500-4(1966). (ORNL-P-1525).

For transition energies $\omega \gg mc^2$ (rest-energy of the electron) previously derived exact analytical results for the internal conversion coefficients (ICC) for all shells and for all transition energies (point-nucleus, no screening model) simplify considerably. It is found to lowest order in $1/\omega$ that the ICC are proportional to $1/\omega$ and that for a particular Z and shell designation, the electric and magnetic ICC for all multipoles are equal. The corresponding numerical results are presented for the K, L and M subshells. (auth)

24390 SYSTEMATICS OF ABSOLUTE GAMMA-RAY TRANSITION PROBABILITIES IN DEFORMED ODD-MASS NUCLEI. Loebner, K. E. G. (Instituut voor Kernphysisch Onderzoek, Amsterdam); Malmskog, S. G. Nucl. Phys., 80: 505-44(1966).

All available experimentally determined absolute gamma-ray transition probabilities between different intrinsic states of deformed odd-mass nuclei in the rare earth region $153 \leqq A \leqq 181$ and in the actinide region $227 \leqq A \leqq 251$ are compared with theoretical transition probabilities (Weisskopf and Nilsson estimate). Systematic deviations from the theoretical values are found. Possible explanations for these deviations are given. The discussion includes Coriolis coupling, $\Delta K = \pm 2$ band-mixing effects and pairing interaction. (auth)

24391 FIRST AND SECOND ORDER CORRECTIONS TO THE MAGNETIC MOMENTS OF NUCLEI USING REALISTIC INTERACTIONS. Mavromatis, H. A.; Zamick, Larry; Brown, G. E. (Princeton Univ., N. J.). Nucl. Phys., 80: 545-64(1966).

First and second order corrections to the magnetic moments of nuclei near closed shells are calculated using the semi-realistic hard core Kallio-Kolltveit interaction. While configurational admixture to first, second or higher orders in perturbation theory is not the sole agency producing corrections to the Schmidt values, for most nuclei it accounts for much of the inward deviation from the Schmidt lines. For nuclei like ^{17}O, ^{41}Ca where there is no first-order correction to the magnetic moment configurational admixture and second-order perturbation theory must be included in an analysis of the experimental deviation. It is found that for ^{17}O the second-order effect is too large, and another mechanism working in the opposite direction is required, while for ^{41}Ca the second-order effect accounts for the experimental deviation. (auth)

24392 ELASTIC SCATTERING OF ^{3}He BY ^{12}C. Schapira, J. P. (Univ. of Manchester, Eng. Institut du Radium, Orsay, France); Newton, J. O.; Blake, R. S.; Jacobs, D. J. Nucl. Phys., 80: 565-76(1966).

The excitation functions for the elastic scattering of ^{3}He by ^{12}C were studied at laboratory angles of 15°, 55°, 125° and 165° in the range of bombarding energy from 2 Mev to 6.1 Mev. Detailed angular distributions were measured at eight bombarding energies between 4.45 Mev and 5.976 Mev. Prominent maxima in the 165° excitation function were observed at bombarding energies of about 5.0 and 5.7 Mev. An unsuccessful attempt was made to interpret the data in this region as arising from optical model scattering together with resonant scattering from two states of the compound system. (auth)

24393 REACTION $^{12}C(d,n_0)^{13}N$ AND $^{12}C(d,p_0)^{13}C$ AT DEUTERON ENERGIES FROM 2.7 to 3.2 Mev. Gudehus, T.; Cosack, M.; Felst, R.; Wahl, H. (Univ., Hamburg). Nucl. Phys., 80: 577-87(1966).

The differential cross sections of the $^{12}C(d,n_0)^{13}N$ and the $^{12}C(d,p_0)^{13}C$ reactions were measured in the deuteron energy range from 2.7 to 3.2 Mev. The data could be fitted assuming a direct and a single resonance amplitude. The parameters of the compound resonance are consistent for both reactions. For the $^{12}C(d,n_0)$ reaction the analysis gives $\Gamma = 65 \pm 10$ kev, $E_R = 3.02 \pm 0.02$ Mev and for the $^{12}C(d,p_0)$ reaction $\Gamma = 77 \pm 10$ kev and $E_R = 3.01 \pm 0.02$ Mev. (auth)

24394 PAIR PRODUCTION IN Al, Sn, Ta, AND Au BY 2.62 Mev GAMMA RAYS. Titus, F.; Levy, A. J. (Dartmouth Coll., Hanover, N. H.). Nucl. Phys., 80: 588-92 (1966).

The pair-production cross sections of Al, Sn, Ta and Au at 2.62 Mev were measured in terms of the differential Compton scattering cross section at the same energy. The measured cross sections are (in b) 0.059 ± 0.010, 0.98 ± 0.06, 2.32 ± 0.13 and 2.89 ± 0.15 for Al, Sn, Ta and Au, respectively. These cross sections and the dependence upon atomic number of the cross sections are in close agreement with the results of Dayton. (auth)

24395 g-FACTOR OF THE 87 kev EXCITED STATE IN ^{155}Gd. Hrynkiewicz, A. Z.; Ogaza, S.; Styczen, J.; Hrastnik, B.; Pudlowska, B.; Kulessa, R. (Inst. of Nuclear Physics, Krakow). Nucl. Phys., 80: 608-16(1966).

The g-factor of the 87 kev state in ^{155}Gd was measured by observation of the perturbation of the angular correlation in an external magnetic field in melted metallic sources, using both integral and differential techniques. The results are in good agreement with the value obtained indirectly from the magnetic hfs-coupling in an aqueous source. The structure of the 87 kev level is discussed on the basis of the average value $g = -0.376 \pm 0.026$. (auth)

24396 POLARIZATION AND ASYMMETRY IN $^{3}He(d,p)^{4}He$. Duck, Ian (Rice Univ., Houston, Tex.). Nucl. Phys., 80: 617-24(1966). (TID-22095).

The polarization P, asymmetry A (for a polarized target) and angular distribution in $^{3}He(d,p)^{4}He$ were analyzed in terms of the most general transition matrix allowed by the requirements of Galilean invariance and reflection invariance. The conditions for which $P = -A$ (in crude agreement with experiment) were determined. A multipole expansion of the amplitudes is presented and a fit to the lowest energy data available is obtained by considering $S_{1/2}$, $P_{1/2}$ and $P_{3/2}$ angular momentum states only. (auth)

24397 OPTICAL MODEL FOR ELASTIC SCATTERING OF 75 AND 150 Mev PROTONS. Rolland, C.; Geoffrion, B.; Marty, N.; Morlet, M.; Tatischeff, B.; Willis, A. (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). Nucl. Phys., 80: 625-42(1966). (In French).

Cross sections and polarizations were measured for elastic scattering of 150 Mev protons on C, Ca and Bi and of 75 Mev protons on C, Ca, Ce and Bi. An optical model analysis was made which gives, general agreement with parameters extrapolated from lower energy fits. However, at 150 Mev, different radii are needed for the real and imaginary parts of the central potential to fit the polarization curves; negative imaginary spin orbit depth is necessary. (auth)

24398 SUM RULE AND TWO-NUCLEON CORRELATIONS IN NUCLEI. Sitenko, A. G.; Simenog, I. V. (Inst. of Physics, Kiev). Nucl. Phys., 80: 643-56(1966).

Inelastic scattering of fast electrons on nuclei and two-particle correlations in nuclei are considered. A general relation is established between the inelastic scattering cross section and two-particle correlation functions for nucleons in a nucleus. The spectral distributions of the two-particle correlation functions are calculated on basis of the shell model. The double magic nuclei ^{4}He, ^{16}O and ^{40}Ca are considered as examples. The sum rules for the correlation functions are derived. With ^{4}He as an example, the effect of the motion of the center of inertia on the correlation functions is examined. (auth)

24399 SEARCH FOR POST-END-POINT ELECTRONS AND FOR EVIDENCE OF NEUTRINO DEGENERACY. Hsue, S. T.; Langer, L. M.; Spejewski, E. H.; Tang, S. M. (Indiana Univ., Bloomington). Nucl. Phys., 80: 657-73 (1966).

A search was made for electrons whose energy might be higher than the Fermi end point in the decay of ^{63}Ni. Such excess energy might be derived from the absorption of neutrinos from positive energy states at the top of the degenerate sea. By combining the electron energy sensitivity of a Li-drifted silicon detector with the momentum selectivity of a magnetic spectrometer, it was possible to distinguish real counts from those arising from background or scattering. The results set an upper limit of 250 ev for the Fermi level if the fraction of occupied neutrino levels, $X_+(E_0) = 1$. Also if $1 > X_+ > 0.1$, then 250 eV < max (E_F) < 530 ev. Because of resolution limitations, however, a lower limit of zero for the Fermi energy is possible. (auth)

24400 OSCILLATOR SHELL MODEL APPROACH TO HYPERFRAGMENTS. Brink, D. M.; Grypeos, M. E. (Clarendon Lab., Oxford). Nucl. Phys., 80: 681-90(1966).

The problem of the calculation of the binding energy $B_\Lambda(A)$ of a Λ particle in finite hypernuclei is investigated in the framework of the oscillator shell model. Expressions for $B_\Lambda(A)$ (with $A \leqq 17$) are obtained and modifications required by the presence of the hard core in the Λ-nucleon potential are discussed. The results of the numerical calculations are compared with the current experimental data. (auth)

24401 NUCLEAR MASSES AND DEFORMATIONS. Myers, William D.; Swiatecki, Wladyslaw J. (Univ. of California, Berkeley). Nucl. Phys., 81: 1-60(1966).

A semi-empirical theory of nuclear masses and deformations is presented. The potential energy of a nucleus, considered as a function of N, Z and the nuclear shape, is assumed to be given by the liquid-drop model, modified by a shell correction. The shell correction is a simple function of N and Z and is supposed to disappear as the nucleus is distorted away from the spherical shape. The resulting semi-empirical expression for the nuclear deformation energy has seven adjustable parameters, four in the liquid-drop part and three in the shell correction. By making the deformation energy stationary with respect to distortions, the equilibrium deformations (i.e., the quadrupole moments) and the ground-state masses of nuclei are derived as functions of N and Z. In addition, from unstable shapes of equilibrium corresponding to saddle-point configurations, barrier energies for nuclear fission are deduced. The predictions of the theory are compared with some 1200 experimental nuclear masses, 240 quadrupole moments and 40 fission barriers. The results lead, on the one hand, to a re-assessment of the accuracy of the liquid-drop model and a firmer determination of its characteristic constants and, on the other, to a semi-quantitative understanding of the effects of shell structure on nuclear masses and deformations. A number of minor anomalies are isolated, one apparently related to the so-called Wigner term in the binding energy and one relevant for the understanding of fission barriers. Applications to the analysis of the centrifugal stretching of nuclei and to the possible existence of "islands of stability" in the region of superheavy nuclei are mentioned. (auth)

24402 ESTIMATES OF THE VARIATION OF NUCLEAR FISSILITIES THROUGHOUT THE PERIODIC TABLE. Nix, James Rayford (Univ. of Copenhagen); Sassi, Elena. Nucl. Phys., 81: 61-70(1966).

The expected variation of nuclear fissilities throughout the periodic table is examined by considering the competition between fission and neutron and proton emission during the de-excitation of an excited compound nucleus. Fission barriers and particle binding energies, upon which the competition depends, are evaluated on the basis of the liquid-drop model; nuclear level density parameters are taken proportional to the atomic mass number. The examination indicates that, contrary to what has been supposed previously, the fissilities of elements lighter than about silver should increase with decreasing Z^2/A. (auth)

24403 ELLIOTT'S CLASSIFICATION AND THE ^{20}Ne ROTATIONAL BANDS. Abulaffio, Carla (Technion-Israel Inst. of Tech., Haifa). Nucl. Phys., 81: 71-5(1966).

The positive parity spectrum of ^{20}Ne is calculated, using the Elliott classification as zero order scheme. Of the eight experimentally well known lowest levels five are successfully identified as belonging to the two lowest SU_3 bands, which can be built with four particles in the sd shell. The other three levels are attributed to excitations of the core, which are described in terms of SU_3 bands. The interpretation is then compared with the different conclusions of two recent theoretical works. (auth)

24404 FINITE-RANGE EFFECTS IN DOUBLE STRIPPING REACTIONS. Bencze, Gy.; Zimanyi, J. (Central Research Inst. for Physics, Budapest). Nucl. Phys., 81: 76-80(1966).

The finite-range effects in double stripping reactions are investigated by means of the "local energy approximation." It is found that the effect of the finite range forces reduces the contribution of the nuclear interior and changes the shape of the reaction form factor. (auth)

24405 REACTIONS (p,pn), (p,2n) AND (p,n) ON ^{89}Y INDUCED BY HIGH-ENERGY PROTONS. Levenberg, I.; Pokrovsky, V.; Tarasova, L.; Van Cheng-Peng; Yutlandov, I. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., 81: 81-7(1966).

The reactions (p,pn), (p,2n) and (p,n) on ^{89}Y were studied in the proton energy range from 120 to 670 Mev. The cross sections of these reactions decrease with proton energy from 95.5 mb, 15.0 mb and 5.8 mb at 120 Mev to 62.0 mb, 3.1 mb and 1.5 mb at 670 Mev, respectively. The dependence of the ratio $\sigma_{p,2n}/\sigma_{p,n}$ upon incident proton energy and mass number of the target nucleus is discussed. (auth)

24406 ENERGY LEVELS OF ^{166}Er EXCITED IN THE DECAY OF ^{166}Tm. Zylicz, J.; Joergensen, M. H.; Nielsen, O. B.; Skilbreid, O. (Univ. of Copenhagen). Nucl. Phys., 81: 88-112(1966).

The electron capture decay ^{166}Tm → ^{166}Er was investigated in a six-gap β-ray spectrometer and with Ge(Li) γ-ray detectors. Conversion lines, single γ-ray spectra and $e-\gamma$ coincidence relations were extensively studied. The results with respect to the ground-state band and the gamma-vibrational band of ^{166}Er are in good agreement with those of earlier investigations. Above the gamma-vibrational band, ten levels are definitely established, having the following energies (in kev), spin values and parities: 1460, $(2)^-$; 1516, 3^-; 1574, $(4)^-$; 1920, 3^-; 1941, (2 or 3)$^+$; 1980, (2, 3 or 4)$^+$; 2004, $(4^-$?); 2135, 3^+; 2162, 3^+ and 2218, (1, 2, or 3)$^-$. Further three levels are suggested at 1530, 2023 and 2293 kev. The 1590 kev and 1687 kev (5^-) levels found in other investigations are probably also populated in the decay of ^{166}Tm. The decay scheme accounts for 70 of the 90 γ-transitions observed in the present work. The structure of the levels of ^{166}Er is discussed in terms of current nuclear models. In particular, the 1460 kev level is interpreted as an octupole-vibrational $K = 2^-$ state, with the associated rotational band having parameters $A = 9.5$ kev and $B = -10$ ev. Evidence for a complicated structure of the 2135 kev 3^+ state is presented. (auth)

24407 SUPERALLOWED log ft VALUES FOR TRANSITIONS BETWEEN $T = \frac{3}{2}$ ANALOG STATES. Hardy, J. C.; Verrall, R. I.; Bell, R. E. (McGill Univ., Montreal). Nucl. Phys., 81: 113-19(1966).

The log ft values were measured for a number of β^+-decay branches from the delayed proton precursors ^{21}Mg, ^{25}Si, ^{29}S, ^{33}Ar, and ^{37}Ca by comparing the intensity of peaks in their delayed proton spectra with that of peaks in the spectrum following the decay of ^{17}Ne. In particular, each decay has a superallowed branch from $(T, T_z) = (\frac{3}{2}, -\frac{3}{2})$ precursor ground state to the $(\frac{3}{2}, -\frac{1}{2})$ analog level in its daughter nucleus. The measured log ft values for these branches agree quite well with calculations and are, in order, 2.9, 3.0, 3.1, 3.6 and 3.3, all values being ±0.3. (auth)

24408 THEORETICAL KOTANI NUCLEAR PARAMETERS FOR THE FIRST-FORBIDDEN BETA TRANSITIONS OF THE ^{170}Tm, ^{175}Yb AND ^{176m}Lu NUCLEI. Bogdan, D. (Inst. of Atomic Physics, Bucharest). Nucl. Phys., 81: 120-8(1966).

Using the Foldy-Wouthuysen expressions for the nonrelativistic forms of the relativistic operators, the Kotani nuclear parameters for the first forbidden beta transitions of ^{170}Tm, ^{175}Yb and ^{176m}Lu nuclei were calculated both in the conventional and in the conserved vector current (CVC) theories. With these parameters the theoretical values of the measured quantities were obtained. For the shape correction factors and for ft values the influence of the nuclear finite size effects and the fourth order term in the ξ expansion are considered, and agreement between theoretical and experimental values of the shape factors were found. It was also found that the difference between

the conventional and conserved vector current theories predictions has no practical significance. (auth)

24409 NEW MASS LAW WITH SHELL AND DEFORMATION CORRECTIONS. Kuemmel, H.; Mattauch, J. H. E.; Thiele, W. (Max-Planck-Institut fuer Chemie, Mainz). Nucl. Phys., 81: 129-54(1966).

Extending earlier work, mass formulas including liquid-drop terms as well as phenomenological shell-model corrections were computed. The change of both due to nuclear deformations was taken into account. For pairing terms phenomenological descriptions as well as an interpolated form of the BCS theory were used. As an example, a mass formula with 43 parameters and a mean deviation between experimental and theoretical masses of less than 300 kev was obtained. Deformations and deformation energies were computed. (auth)

24410 HALF LIFE OF ^{8}Li. Claassen, D. H.; Dinter, H. (Univ., Erlangen-Nuernberg, Ger.). Nucl. Phys., 81: 155-60(1966). (In German).

The ^{8}Li nucleus was produced by the reaction ^{7}Li(d,p)^{8}Li. The half life of the β-decay ^{8}Li $\rightarrow$ ^{8*}Be was measured by observing the α particles from the disintegration ^{8}Be $\rightarrow 2\alpha$, which follows the β-decay in about 10^{-22} s. The α activity was recorded for ten half lives of ^{8}Li by semiconductor detectors. The influence of background and disturbing reactions was investigated. The results are $T_{1/2} = 0.8440 \pm 0.0007$ s, log $ft_{1/2} = 5.66$. (auth)

24411 LARGE-ANGLE ELASTIC SCATTERING OF ALPHA PARTICLES BY ^{39}K, ^{40}Ca, ^{42}Ca, ^{44}Ca, AND ^{50}Ti. Gruhn, C. R. (Massachusetts Inst. of Tech., Cambridge. Michigan State Univ., East Lansing); Wall, N. S. Nucl. Phys., 81: 161-79(1966).

Elastic scattering of 30.5 Mev alpha particles by ^{39}K, ^{40}Ca, ^{42}Ca, ^{44}Ca and ^{50}Ti was observed over the angular range from 30 to 170° cm. The energy dependence between 27 and 40 Mev of the elastic scattering of alpha particles by ^{40}Ca was studied over the same angular range. The most striking feature of the data is the large-angle behavior. The last few maxima of the large angle oscillatory pattern remain relatively fixed in angle as both the energy and A are changed. The intermediate angular region appears to result from an interference between the large-angle oscillatory pattern and the forward-angle diffraction pattern. Data are also given for the inelastic scattering of alpha particles from the 2^+ states, Q = −1.54 and −1.56 Mev, of ^{42}Ca and ^{50}Ti, respectively. (auth)

24412 SINGLET DEUTERON PICK-UP REACTIONS. Nomoto, Morikazu (Niigata Univ., Japan). Nucl. Phys., 81: 180-92(1966).

The singlet deuteron pick-up reaction in the reaction A(p,p′n)B is studied theoretically. The energy spectra and the angular distributions of the proton from this reaction by the singlet deuteron pick-up process as well as by the direct three-body break-up process are calculated with the plane wave Born approximation and a finite range p-n interaction potential. The formulas obtained are applied to the reactions ^{13}C(p,p′n)^{12}C with the incident proton energy E_p = 15 Mev (in the lab system) and ^{9}Be(p,p′n)^{8}Be with E_p = 5 Mev, and the contributions of the singlet deuteron pick-up process to the emitted proton spectra and the angular distributions are discussed. These contributions are compared to those of the other processes. (auth)

24413 FIRST EXCITED STATE OF ^{16}O AND STRONGLY DEFORMED EXCITED STATES IN NUCLEI HAVING SPHERICAL GROUND STATES. Hayward, J. (Univ. of Cambridge, Eng.). Nucl. Phys., 81: 193-214(1966).

The energies of a number of states in ^{16}O and ^{18}O were calculated as functions of the deformation of the nucleus. The anisotropic h.o. single-particle Hamiltonian and a Gaussian two-body interaction were used. The results were very sensitive to the exchange mixture. Using the Gillet mixture a four-particle excited, strongly deformed, wave function is a good description of the 6.06 Mev state in ^{16}O, although it probably contains rather too much collective motion. With the Soper mixture this state is not explained in our simple model since neither the two nor the four particle excited states have a sufficiently low energy and there is not a great deal of mixing between them. The two-particle excited state of ^{18}O also comes down very low if the Gillet mixture is used, and deform, but not if the Soper mixture is used. In general, strong exchange mixtures increase the energy gain on deformation and the position of the equilibrium deformation. (auth)

24414 GAMMA-RAY ANGULAR DISTRIBUTION EMITTED AFTER EXCITATION OF NUCLEI. Djrbashian, V. A. (Inst. of Physics, Yerevan, USSR). Nucl. Phys., 81: 215-19(1966).

Formulas are derived for the angular distribution of γ rays following the electromagnetic excitation of nuclei by particles with arbitrary spin. (auth)

24415 PROTON SPECTRA FROM THE REACTION D(n,p)2n AT DIFFERENT ENERGIES. Debertin, K.; Hofmann, K.; Roessle, E. (Johann-Wolfgang-Goethe-Univ., Frankfurt am Main). Nucl. Phys., 81: 220-4 (1966).

Energy spectra of protons emitted from the reaction D(n,p)2n at emission angles up to 60° were measured with a scintillation counter telescope at bombarding energies of 8.4, 14.1 and 22 Mev. (auth)

24416 THREE-QUASI-PARTICLE STATE IN ^{165}Er. Bonch-Osmolovskaya, N. A.; Gromov, K. Ya.; Chu, Wang Chang (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., 81: 225-32(1966).

The intensities of gamma transitions from the 1428 kev level in the ^{165}Er nucleus were measured. The corresponding multipolarities were deduced. A conclusion is drawn on the spin of the 1428 kev level and its structure is considered. (auth)

24417 HIGHLY EXCITED ISOMERIC STATE IN ^{130}Ba. Brinckmann, H. F.; Heiser, C.; Alexander, K. F.; Neubert, W.; Rotter, H. (Vereinigtes Institut fuer Kernforschung, Dubna, USSR. Zentralinstitut fuer Kernforschung, Rossendorf, Dresden). Nucl. Phys., 81: 233-40(1966). (In German).

In the reaction ^{122}Sn(^{12}C,4n)^{130}Ba a highly excited isomeric state with a half-life of 8.8 ± 0.2 ms was observed. The assignment to ^{130}Ba follows from the excitation functions and from the good agreement of the γ-lines 350 ± 5 kev, 555 ± 5 kev and 690 ± 5 kev observed in the delayed spectrum with the well-known first three transitions in the rotational band of ^{130}Ba. A further γ-line of 870 ± 5 kev observed in this experiment might be interpreted as a K-forbidden isomeric transition leading to the 6^+ level of the rotational band. However, another possibility, that the isomeric transition has an energy <25 kev and was therefore not detected, cannot be excluded. In this case the 870 kev transition would be the fourth member of the rotational band. Several arguments concerning spin and parity of the isomeric state are reviewed. The most probable assignment seems to be $J^{\pi} = 8^-$. (auth)

24418 THE OPTICAL MODEL. Sengupta, Hiranmay (Univ. of Dacca, Pakistan). Nucl. Sci. Appl., 1: 39-47 (Dec. 1965).

A general discussion of the nuclear optical model is presented. Topics discussed are parameters of the optical model, mathematical formulation, and analysis of experimental results. (B.G.D.)

24419 INTEGRAL ^{9}Be(n,2n) CROSS SECTION. Felber, F. F. Jr.; Farmelo, D. R.; Van Sickle, V. C. Nucl. Sci. Eng., 25: 1-7(1966).

The integral ^{9}Be(n,2n) cross section was determined by using Be and BeO samples irradiated in the core of the Battelle Research Reactor. The value obtained was 460 ± 60 mb for neutrons having energies above 2.7 Mev and a

fission spectrum. Fast-neutron dosimetry was accomplished using iron, nickel, and titanium threshold detectors. The results are based on measurement of the total amount of helium produced during irradiation. Corrections were made for the small contribution from (n,α) reactions on ^{9}Be and ^{16}O. (auth)

24420 BURNUP CROSS SECTIONS AND RESONANCE INTEGRALS OF DYSPROSIUM. Scoville, J. J.; Fast, E.; Rogers, J. W. Nucl. Sci. Eng., 25: 12-20(1966).

Natural dysprosium was irradiated by 3×10^{21} n/cm^2, more than twice that previously reported. The cross section relative to the initial value dropped to 35% for 1×10^{21} n/cm^2, then varied more slowly to about 25% at the maximum exposure. Good agreement was obtained between theoretical calculations and experimental results, including the isotopic distribution in the irradiated samples. Thermal cross sections and infinitely dilute resonance-absorption integrals of five major isotopes and the natural element were measured and used in the above calculations. These values are tabulated. Of note is significant resonance integral for ^{160}Dy for which no parameters have been reported. (auth)

24421 PARAMETERS OF NEUTRON RESONANCES IN ^{184}W. Khan, F. A.; Harvey, J. A. Nucl. Sci. Eng., 25: 31-6(1966). (ORNL-P-1712).

Transmission measurements on samples of natural tungsten (W) and samples enriched in ^{184}W were made with the ORNL fast-chopper time-of-flight spectrometer. The measurements were made at the 180-m flight station with a resolution of ≈ 10 n sec/m between 40 and 10000 ev, and at the 45-m station with an energy resolution from 0.7 to 1.5% between 0.2 and 100 ev. The transmission data were analyzed to give the parameters for 16 resonances in ^{184}W up to 2100 ev. From these parameters the following data for ^{184}W were determined: an average neutron level spacing of 110 ± 30 ev, an s-wave neutron strength function of (3.1 ± 1.1) 10^{-4}, and a radiative-capture resonance integral of 12 ± 2 b. (auth)

24422 DETERMINATION OF THE EFFECTIVE CROSS SECTION OF THE $^{46}Ti(n,p)^{46}Sc$ REACTION FOR A LIGHT WATER-MODERATED REACTOR. Koehler, W. (Technische Hochschule, Munich). Nukleonik, 8: 9-15(Jan. 1966). (In German).

The determination of the integral flux density of fast neutrons in irradiation in reactors is often done with titanium probes. The effective cross section of the reaction $^{46}Ti(n,p)^{46}Sc$ was therefore determined relative to the reaction $^{32}S(n,p)^{32}P$ ($\sigma = 7.6 \pm 0.25$ mb). Good agreement is obtained with the reports of some recent studies. The other two titanium reactions $^{47}Ti(n,p)$ and $^{48}Ti(n,p)$ showed no agreement. The pattern of (n,p) effective cross section of these three reactions and of the comparison reaction was calculated by the statistical theory and the mean value $\sigma(E > 1$ Mev) was compared. For ^{47}Ti (odd A) a relatively good agreement was obtained whereas for ^{46}Ti and ^{48}Ti no agreement was possible when the values calculated for odd A were increased by a factor of 5. (tr-auth)

24423 NUCLEAR RECOILS IN SOLIDS. 6. THE REACTION $^{58}Ni(n,p)^{58}Co$. Oberhauser, R.; Wiechmann, W. (Institut fuer Kernforschung, Berlin). Nukleonik, 8: 59(Jan. 1966). (In German).

The mean range of recoil particles in nickel arising from the reaction $^{58}Ni(n,p)^{58}Co$ was determined using the target-capture method. A mean range of 3.85×10^{-6} cm with a mean error of ±2% was obtained. (J.S.R.)

24424 THE EFFECTIVE CROSS SECTION FOR THE REACTION $^{33}S(n,p)^{33}P$. Koehler, W.; Knopf, K. (Technische Hochschule, Munich). Nukleonik, 8: 59-60(Jan. 1966). (In German).

Various types of irradiations of sulfur compounds and the subsequent separation of ^{32}P and ^{33}P by the absorption method showed that the reaction $^{33}S(n,p)^{33}P$ does not proceed with thermal neutrons and that the per cent concentration of ^{33}P in sulfur irradiations is higher by a factor of 2 in light water moderated reactors than in irradiations in graphite reactors or in heavy water reactors. The effective cross section of the reaction was measured using $(NH_4)_2SO_4$ (bare and cadmium-covered) and with K_2SO_4. A mean value of 376 ± 20 mb was obtained. (J.S.R.)

24425 THREE-BODY ANALYSIS OF Λ-Λ FORCE THROUGH THE BINDING ENERGIES OF DOUBLE HYPERFRAGMENTS. Monga, S. K.; Mitra, A. N. (Univ. of Delhi). Nuovo Cimento (10), 42: 1004-8(Apr. 21, 1966).

The binding energy is calculated of $_{\Lambda\Lambda}He^{6}$ regarded as an (α + 2Λ) problem, and of $_{\Lambda\Lambda}Be^{10}$ as a (2Λ + ^{8}Be) system, using an approach similar to that for obtaining the binding energy as an exact eigenvalue problem from a one-dimensional Fredholm equation provided separable potentials are used between all particle pairs. The existence of a low-energy Λ-Λ attraction is indicated from the analyses of the binding energy for both cases. (L.B.S.)

24426 TREATMENT OF NEUTRON-PROTON PAIRING CORRELATIONS BY MEANS OF A GENERALIZED BOGOLIUBOV TRANSFORMATION. Camiz, P. (Istituto Nazionale di Fisica Nucleare, Rome. Institut de Physique Nucleaire, Orsay, France); Covello, A.; Jean, M. Nuovo Cimento (10), 42B: 199-237(Apr. 11, 1966).

The Bogoliubov-Valatin transformation was generalized to include neutron-proton pairing correlations, i.e., the part of the neutron-proton (n,p) residual interaction which is effective for pairs of nucleons coupled to J = 0, T = 1. The proposed method thus treats n-n, p-p, and n-p pairing on the same footing. The general formalism was first established for the realistic case of many j shells and then applied to the single-j model with a charge-independent pairing interaction. It was shown, by comparison to the exact solutions of the model, that this generalization of the B.C.S. method has the same degree of accuracy than the ordinary one. Furthermore it is observed that the state of lowest energy is obtained when the transformation reduces to a product of two ordinary Bogoliubov transformations performed separately on neutrons and protons. It is to be noticed that the transformations conserve neither T_z, the z-component of the isobaric spin T, nor T^2. In this connection the usefulness of introducing a constraint on the expectation value of T^2 was emphasized. (auth)

24427 TWO-BODY NONMESONIC DECAY MODES OF $^{4}He_{\Lambda}$ AND $^{4}H_{\Lambda}$. Rayet, M. (Clarendon Lab., Oxford). Nuovo Cimento (10), 42B: 238-50(Apr. 11, 1966).

The reaction rates for the two-body nonmesic decays $^{4}H_{\Lambda} \rightarrow {}^{3}H + n$ (1), $^{4}He_{\Lambda} \rightarrow {}^{3}He + n$ (2) and $^{4}He_{\Lambda} \rightarrow {}^{3}H + p$ (3) are calculated using a phenomenological nonrelativistic matrix element. This matrix element describes all transitions allowed in the weak process ΛN → NN where the Λ-hyperon interacts with the nucleons in $^{1}S_0$ and $^{3}S_1$ states. The reaction rates are given as a function of the six independent transition amplitudes contained in the matrix element and are compared with the total nonmesic decay rates for $^{4}H_{\Lambda}$ and $^{4}He_{\Lambda}$. These total rates have been expressed in terms of the same transition amplitudes from expressions given by Block and Dalitz. The ratios of the two-body decay rates on the total rates for the corresponding hypernucleus appear to be small. Taking into account only the transition $^{3}S_1(\Lambda N) \rightarrow {}^{3}P_1$ (NN), which is expected to be dominant, a rough estimate of these ratios, 3% for reaction (1) and 1.5% for reaction (2) and for reaction (3), is obtained. (auth)

24428 INFLUENCE OF THE SHELL STRUCTURE ON NUCLEI NEAR N = Z = 28. Garfagnini, R.; Pasqualini, L.; Piragino, G. (Univ., Turin. Istituto Nazionale di Fisica Nucleare, Turin). Nuovo Cimento (10), 42B: 290-6(Apr. 11, 1966).

The comparison between the total photonuclear and total photoneutron cross sections shows noticeable change of the ratio between the competitive processes for the nuclei close to the N = Z = 28 shells. It is shown that the different behavior of nickel with respect to cobalt and copper can be in part accounted for by considering the influence of the shell structure on the level density in the compound nucleus model. (auth)

24429 STUDY OF THE Ne(n,p)F REACTION. Kondaiah, E.; Patell, R. (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 42B: 297-305(Apr. 11, 1966).

The Ne(n,p)F reaction is studied at (14.1 ± 0.1) Mev neutron energy using natural neon gas as target and nuclear emulsion as detector. Hydrogen gas is used as standard and the cross-section for the Ne(n,p)F reaction is determined by comparison as (142 ± 28) mb. The angular distributions of protons from hydrogen as well as neon gas targets are given. The angular distribution in the case of hydrogen agrees with known results; in the case of neon, the angular distribution is symmetric around 90° cm. The neon angular distribution fits well with a 2nd-order Legendre polynominal $1 + \alpha_2 P_2(\cos\theta)$ with $\alpha_2 = 1.35 \pm 0.2$. Assuming the energy distribution to be Maxwellian, the temperature of the residual nucleus is determined as T = (1.48 ± 0.20) Mev and the level density parameter α = (3.96 ± 0.50) Mev^{-1} from the observed proton energy distribution in the case of neon; from these, it is concluded that the Ne(n,p)F reaction is essentially a compound-nucleus reaction at this energy. Using $\alpha_2 = 1.35 \pm 0.2$, the spin cut-off parameter $\sigma = 1.10$ and moment of inertia $I = 0.3\ I_{rigid}$ are obtained. (auth)

24430 PHOTONEUTRONS FROM ^{9}Be. Costa, S.; Pasqualini, L.; Piragino, G.; Roasio, L. (Univ., Turin. Istituto Nazionale di Fisica Nucleare, Turin). Nuovo Cimento (10), 42B: 306-13(Apr. 11, 1966).

Photoneutron emission from beryllium was investigated between 6 and 80 Mev, by using a thermalized neutron detector. Some levels suggested in the literature seem to be confirmed. The cross-section averaged from 20 to 80 Mev is 2.8 mb. The integrated and the bremsstrahlung-weighted cross-sections are in agreement with sum rule calculations. (auth)

24431 CHARGED PHOTOPARTICLES FROM NATURAL LITHIUM. Manuzio, G. E.; Ricco, G.; Sanzone, M. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cimento (10), 42B: 348-54(Apr. 11, 1966).

Charged-photoparticle's spectra from natural lithium were measured using a solid-state counter telescope, and the bremsstrahlung beam of a 32 Mev betatron. The ^{7}Li(γ,t)^{4}He cross section shows a great deal of structure corresponding to excitation of levels in the region of the giant resonance. Also the proton spectrum exibits a complex structure possibly due to ^{7}Li(γ,p)^{6}He and ^{7}Li(γ,p)^{6}He* reactions. (auth)

24432 ENERGY SPECTRUM AND POLARIZATION OF PHOTONEUTRONS FROM ^{9}Be. De Marco, A.; Garfagnini, R.; Piragino, G. (Univ., Turin. Istituto Nazionale di Fisica Nucleare, Turin). Nuovo Cimento (10), 42B: 355-7(Apr. 11, 1966).

The energy spectra and the polarization of photoneutrons from the ^{9}Be(γ,n) at $E_{\gamma\ max}$ of 85 Mev were measured. The experimental distribution for $E_n < 4$ Mev is explained in terms of a large contribution of low-energy neutrons from channels other than the ground-state (^{8}Be + n) channel. A noticeable contribution to the polarization from the neutrons emitted in the processes involving the ^{9}Be core is supposed to explain the high polarization value of the photoneutrons with energy $1 < E_n < 3$ Mev. (L.B.S.)

24433 RADIOCHEMICAL STUDY ON PHOTONUCLEAR REACTIONS ABOVE THE MESONIC THRESHOLD. II. PHOTOREACTIONS PRODUCED ON ^{55}Mn BY 1 Gev BREMSSTRAHLUNG. Di Napoli, V. (CNEN, Rome. Univ., Rome); Dobici, F.; Salvetti, F.; De Carvalho, H. G. Nuovo Cimento (10), 42B: 358-62(Apr. 11, 1966).

Measurements are described of the equivalent quantum cross sections for the formation of various products in bremsstrahlung reactions with ^{55}Mn at 1 Bev. (L.B.S.)

24434 POLARIZATION OF PROTONS SCATTERED FROM ^{4}He. Drigo, L.; Manduchi, C.; Nardelli, G. C.; Russo-Manduchi, M. T.; Tornielli, G.; Zannoni, G. (Univ., Padua). Nuovo Cimento (10), 42B: 363-6(Apr. 11, 1966).

Experimental results are tabulated for the energy and angular dependence of the asymmetry A_0 and polarization in proton scattering by ^{4}He at 2.38 to 4.46 Mev. (L.B.S.)

24435 TEST OF EXCHANGE CURRENTS IN LIGHT NUCLEI. Bosco, B.; Quarati, P. (Univ., Cagliari, Italy, Istituto Nazionale di Fisica Nucleare, Turin). Nuovo Cimento (10), 42B: 371-5(Apr. 11, 1966).

Various approaches to the search for observable effects of meson-exchange currents in light nuclei are briefly reviewed. The validity of a test previously proposed for the deuteron utilizing the relation between differential disintegration cross sections with photons and electrons scattered at 180° is examined. A new test that consists in the experimental verification of the angular distributions from 180° electron and photon scattering on simple nuclei is proposed. (L.B.S.)

24436 GENERALIZED BOGOLIUBOV TRANSFORMATION IN NUCLEAR PHYSICS. Salusti, E. (Istituto Nazionale di Fisica Nucleare, Rome. New York Univ.); Varcaccio, G. Nuovo Cimento (10), 42B: 378-81(Apr. 11, 1966).

The possibility of generalizing the usual quasi-particle method in order to take into account the neutron-proton interaction in light nuclei is considered. The approach considered by Camey, Covello, and Jean in which a general Bogoliubov transformation was introduced, which conserves the angular momentum j and mixes neutrons and protons as well as particles and holes, is examined, and the geometric properties of the wave function are analyzed mainly in the parameter-space region near the product of two ordinary Bogoliubov transformations. It is concluded that in the realistic case of many subshells, it may be possible that the minimum energy be given by a generalized Bogoliubov transformation. (L.B.S.)

24437 PHOTODISINTEGRATION OF ^{6}Li. Costa, S.; Ferrero, F.; Manfredotti, C.; Pasqualini, L.; Roasio, L. (Univ., Turin. Istituto Nazionale di Fisica Nucleare, Turin). Nuovo Cimento (10), 42B: 382-4(Apr. 11, 1966).

The photoneutron yield curve for ^{6}Li was measured at 5 to 97 Mev using an improved thermalized neutron detector in order to study the behavior of the photon-absorption cross section, especially at energies higher than 30 Mev. The results are presented and analyzed. (L.B.S.)

24438 ISOTOPE SHIFT AND DEFORMATIONS OF YTTERBIUM NUCLEI. Golovin, A. F.; Striganov, A. R. Opt. Spectros. (USSR) (Engl. Transl.), 19: 467-9(Dec. 1965).

Translated from Opt. Spektros., 19: 837-42(1965).

The isotope shift between the components of the five even ytterbium isotopes has been measured for ten spectral lines of the neutral and singly ionized atom. The relative isotope shift was found to be $\Delta\nu(176-174):\Delta\nu(174-172):\Delta\nu(172-170):\Delta\nu(170-168) = 1.00:(1.10 \pm 0.011):(1.37 \pm 0.004):(1.48 \pm 0.006)$. On the basis of these results the static deformation parameter, $\beta = 0.286 \pm 0.02$, the nuclear quadrupole moment, $Q_0 = (7.33 \pm 0.56) \times 15^{-24}\ cm^2$, and the reduced probability of electric quadrupole transitions from the ground state to the first excited state, $B(E2,0 \rightarrow 2)/e^2 = (5.34 \pm 0.80) \times 10^{-48}\ cm^4$, were calculated for nuclei of the rare isotope ^{168}Yb. (auth)

24439 PRECISION TESTS OF T INVARIANCE IN ELECTROMAGNETIC TRANSITIONS. Henley, E. M.; Jacobsohn, B. A. (Univ. of Washington, Seattle). Phys. Rev. Lett., 16: 706-9(Apr. 18, 1966).

A discussion is presented of precision tests of T invariance in electromagnetic transitions, which were proposed earlier (Phys. Rev., 113: 225 and 234 (1959)), that have accuracies of 1 part in 10^8. (B.G.D.)

24440 ASYMMETRY IN THE INELASTIC SCATTERING OF 40-Mev POLARIZED PROTONS. Fricke, M. P.; Drisko, B. M.; Bassel, R. H.; Gross, E. E.; Morton, B. J.;

Zucker, A. (Oak Ridge National Lab., Tenn.). Phys. Rev. Lett., 16: 746-8(Apr. 25, 1966).

The results of asymmetry measurements of the first excited (2^+) states in ^{28}Si and ^{60}Ni in the inelastic scattering of 40 Mev polarized protons are presented. (B.G.D.)

24441 POLARIZATION STUDY OF AN ISOBARIC ANALOG STATE IN ^{91}Nb. Moore, C. F.; Terrell, G. E. (Texas Univ., Austin). Phys. Rev. Lett., 16: 804-6(May 2, 1966).

A polarization study near the analog state in ^{91}Nb is presented to provide a direct, model independent determination of the spin of the isobaric multiplet. The measurement technique required first that the protons be elastically scattered by a self-supporting, enriched (98.6%) ^{90}Zr target and then elastically scattered at a mean angle of 50° by a thick carbon analyzing target. The polarizations were measured at angles near 60 and 140° since preliminary calculations showed that near l = 2 resonance the magnitude would be the largest at these angles. (B.G.D.)

24442 DECAY OF ISOBARIC ANALOG STATES IN THE LEAD REGION. Kavaloski, C. D.; Lilley, J. S.; Richard, Patrick; Stein, Nelson (Univ. of Washington, Seattle). Phys. Rev. Lett., 16: 807-10(May 2, 1966).

New proton scattering data in the lead region which further demonstrates the usefulness of isobaric analog states for nuclear spectroscopy are presented. It is found that many of the (p,p') resonances corresponding to the analog states have shapes quite different from the symmetric Breit-Wigner shapes observed in previous experiments with lighter nuclei at lower incident energies. (B.G.D.)

24443 PROTON-NUCLEUS INTERACTION AT 20 Bev. Frahn, W. E.; Wiechers, G. (Univ. of Cape Town, Rondebosch, South America). Phys. Rev. Lett., 16: 810-13 (May 2, 1966).

A strong absorption model analysis of the heavy-target data of previous investigations on proton-neutron interactions is presented. The strong absorption model is based on a functional parametrization of the scattering function $\eta_l = S(\lambda)$ and gives simple closed expressions for the differential and integrated cross sections. (B.G.D.)

24444 STUDY OF BETA-GAMMA DIRECTIONAL CORRELATION IN THE $2^-(\beta)2^+(\gamma)0^+$ DECAY OF ^{86}Rb. Rao, W. V. S.; Rao, K. S.; Sastry, D. L.; Jnanananda, S. (Andhra Univ., Waltair, India). Proc. Phys. Soc. (London), 87: 917-26(Apr. 1966).

The energy dependence of the angular correlation in the first-forbidden beta decay of ^{86}Rb is studied with a slow-fast scintillation spectrometer in the beta-energy region 222.5 to 687.5 kev. The assembly and the characteristics of the set-up are given. The angular correlation function obtained from the present work is compared with recent results. An analysis of the experimental data is made for several possibilities to describe the 718 kev beta transition in ^{86}Rb. (auth)

24445 NUCLEAR ORIENTATION OF ^{48}V NUCLEI IN IRON AND COBALT. Cameron, J. A.; Compton, J. P.; Lines, R. A. G.; Wilson, G. V. H. (Oxford Univ.). Proc. Phys. Soc. (London), 87: 927-34(Apr. 1966).

Nuclei of the isotope ^{48}V were aligned in iron and cobalt at temperatures between 0.011 and 0.03°K. From measurements of the γ-radiation anisotropy the hyperfine coupling energies for ^{48}V nuclei in dilute FeV and CoV alloys were determined and a value $|\mu(^{48}V)| = 1.63 \pm 0.10$ n.m. deduced. Some factors of importance in the measurement of γ-radiation anisotropies of order 1% in low-temperature nuclear orientation experiments are discussed. (auth)

24446 TRANSIENT EFFECT IN DYNAMIC NUCLEAR POLARIZATION. Ramakrishna, J.; Robinson, F. N. H. (Oxford Univ.). Proc. Phys. Soc. (London), 87: 945-51 (Apr. 1966).

The recovery of the nuclear magnetic resonance signal in Nd-doped lanthanum magnesium nitrate, which was negatively polarized and then brought to zero polarization by further pumping at the positive polarization frequency, shows that there is a distribution of nuclear relaxation times. The radius of the diffusion barrier is estimated from these experimental results and existing definitions are reviewed. It is argued that spin diffusion is the predominant factor in nuclear relaxation. (auth)

24447 NUCLEAR QUADRUPOLE SPIN-LATTICE RELAXATION IN SINGLE CRYSTALS FOR $I = 3/2$. Hughes, D. G. (Univ. of Alberta, Edmonton). Proc. Phys. Soc. (London), 87: 953-65(Apr. 1966).

The saturation and time-dependent relaxation behavior of a nuclear spin system with $I = 3/2$ in a single crystal is calculated for unequal quadrupole transition probabilities ($W_1 \neq W_2$). Experimental methods of measuring W_2/W_1 are discussed in the light of the results. (auth)

24448 THREE-PARTICLE NUCLEAR SPECTROSCOPY OF ^{91}Y ON THE SHELL MODEL. Kumar, Naresh; Kumar, Vijay; Aggarwal, Gian (Panjab Univ., Chandigarh, India). Progr. Theoret. Phys. (Kyoto), 35: 176-7(Jan. 1966).

The low-lying energy levels in ^{91}Y arising from the coupling of two neutrons in the $2d_{5/2}$ level and a proton in the $2p_{1/2}$ and $1g_{9/2}$ levels outside the ^{88}Sr core were calculated and compared with the calculated results of Aurbach and Talmi and experimental data. Spin and parity assignments were made to various levels, which were found to be in good agreement with experimentally observed levels. (L.B.S.)

24449 NUCLEAR MATTER AND SOFT CORE POTENTIALS. Harada, Minoru; Tamagaki, Ryozo; Tanaka, Hajime (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 35: 177-9(Jan. 1966).

It is shown how differences in calculated potentials affect the binding energy of nuclear matter in the case of S-state interactions, which give large contributions at small distances. The binding energy equation is obtained by solving an integral equation self-consistently in momentum, introducing soft-core potentials instead of hard-core ones. The result is shown for three sets of values of the interaction strengths and ranges along with the result obtained by Wong using the Yukawa core potential. (L.B.S.)

24450 REMARKS ON SHAPE OF REPULSIVE CORE OF NUCLEAR FORCES. Otsuki, Shoichiro (Nagoya Univ., Tokyo); Sawada, Shoji; Tamagaki, Ryozo; Watari, Wataro. Progr. Theoret. Phys. (Kyoto), 35: 181-2(Jan. 1966).

The effects of the Yukawa-shape soft core on the behavior of the singlet S phase shift $\delta(^1S_0)$ for N-N interactions were re-examined by using precise values of the low-energy scattering parameters from a previous analysis. The results of the fit to $\delta(^1S_0)$ up to 310 Mev are tabulated for two types of potentials, and some inferences are made concerning the origin of the repulsive core. (L.B.S.)

24451 MAGNETIC ELECTRON SCATTERING FROM NUCLEI. Goldemberg, J. (Laboratoire de l'Accelerateur Lineaire, Orsay, France); Pratt, R. H. Rev. Mod. Phys., 38: 311-29(Apr. 1966).

The calculations and experimental information available in the studies of electron scattering (elastic and inelastic) from the magnetic-moment distribution of nuclei are reviewed. The corresponding information on the properties of nucleons was reviewed previously and is not discussed. As usual in electron-scattering investigations attention is given mostly to the determination of two functions of the momentum transfer, the charge and magnetic form factors or linear combinations of them, which are closely related to the spatial structure of the charge and magnetic-moment distributions. The discussion is specialized to the magnetic form factor and the nuclear properties connected with it. (auth)

24452 THE EFFECT OF $^3D_1$ STATE OF THE DEUTERON ON REDUCED WIDTHS. Dumitrescu, Ovidiu; Cioaca, Constantin (Bucharest Univ.). Rev. Roum. Phys., 10: 847-61(1965).

Explicit expressions for the reduced widths occurring in the reactions with deuterons were obtained. For the individual nucleons, harmonic oscillator wave functions and for the deuteron, the $^3S_1 + {}^3D_1$-state wave function, obtained as a solution of the Schrödinger equation with tensor forces, were used. (auth)

24453 CHARGE INDEPENDENT PAIRING INTERACTION IN THE NON-DEGENERATE $2s_{1/2}$, $1d_{5/2}$ SHELLS. Guiasu, Ileana; Micu, Liliana (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 909-20(1965).

The influence of the charge-independent pairing interaction in some light nuclei is evaluated by using the generalized quasi-spin method. The nuclear states are classified with the aid of the Sp_4 group generated by the quasi-spin and isospin operators. The results are compared with the experimental data for A = 18, 20, 22, 28, and 30 nuclei. (auth)

24454 A NEW ISOMERIC STATE OF ^{115}Sn. Ivanov, E.; Plostinaru, D.; Alevra, A.; Poenaru, D. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 935-41(1965).

The existence of a short-lived isomeric state of ^{115}Sn [^{115m2}Sn, $T_{1/2}$ = (3.4 ± 0.9) μsec] was found by using the delayed coincidence method and the pulsed proton beam technique at the IAP-U-120 cyclotron. It is a $^7/_2$+ state of 619-kev energy populated by the 107-kev transition from the $^{11}/_2$ − state [^{115m1}Sn, $T_{1/2}$ = 159 μsec] and decaying by a 120 kev transition to the $^3/_2$+ first excited state of ^{115}Sn. The values $\alpha_K(107) = 3.2 \pm 0.4$ and $\alpha_K(120) = 0.64 \pm 0.7$ of the K-conversion coefficients for the two isomeric transitions were measured and they are consistent with a pure M2 transition of 107 kev and a pure E2 transition of 120 kev energy. (auth)

24455 GAMMA RAYS FROM THE ^{75}As(n,γ)^{76}As REACTION. Cristu, M. I.; Popa, M. S. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 949-58 (1965).

By means of a gamma-gamma coincidence spectrometer using two NaI(Tl) crystals, single and coincidence spectra from the ^{75}As(n,γ)^{76}As reaction were measured. More prominent gamma ray peaks appeared at 49.5, 89, 120, 136, and 163 kev in the single spectrum. The coincidence and sum-coincidence measurements revealed the following more intensive cascades: 120−163, 136−163, 163−220−275, 275−540, and 275−660 kev. The data obtained were used for derivation of the probable ^{76}As level scheme with level energies at 163, 283, 390, 480, 590, 660, 940, 1270, 1910, 2150, 2350, and 2550 kev. A discussion about the spins and parities of the lowest levels of ^{76}As nucleus is given. (auth)

24456 EXPERIMENTAL VERIFICATION OF THE BETHE-HEITLER THEORY OF BREMSSTRAHLUNG IN THE ENERGY RANGE 0.150 TO 2.200 Mev. Voljin, Valentina; Ciangiru, Gh. (Univ., Bucharest). Rev. Roum. Phys., 10: 959-75(1965). (In French).

Experimental verification is given for the Bethe-Heitler theory in the energy range 0.150 to 2.2 Mev for lead, tin, and aluminum. The theoretical spectra were calculated using the Bethe-Heitler theory, and corrections for Compton electrons and self-absorption were made for the experimental results. Curves showing the bremsstrahlung spectra obtained experimentally and theoretically are shown for the metals studied. (J.F.P.)

24457 (p,p′γ) ANGULAR CORRELATION IN AN EXCITATION PROCESS OF ALPHA 4^+ STATE. Hulubei, H.; Neamu, I.; Scintei, N.; Berinde, A.; Martalogu, N. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 977-84(1965).

The (p,p′γ) angular correlation function between inelastically scattered protons on the second 4^+ excited state of even-even nuclei and the last gamma radiation of $4^+ \rightarrow 2^+ \rightarrow 0^+$ cascade, in plane wave Born approximation of direct interaction theory is calculated. The comparison with the experimental data of the angular correlation on ^{20}Ne for 8.5 Mev energy, provides indications on the direct interaction contribution to proton scattering on second excited state of ^{20}Ne. (auth)

24458 COLLECTIVE OSCILLATIONS IN TWO-COMPONENT NUCLEAR MATTER. Brandus, I.; Corciovei, A.; Micu, L. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 1051-62(1965).

The two-component (protons and neutrons) nuclear matter with particles interacting through a two-body force of Yukawa well type is considered and its possible longitudinal collective oscillations are studied. Taking the Fourier components of the density matrix as collective coordinates, a nonlinear system of two coupled differential equations is obtained corresponding to the two components of the physical system. Looking for the common harmonic solution of these equations, the general dispersion relation for the frequency in the RPA is obtained. The collective oscillations frequency in the form of a power series in the moment transfer is also found. (auth)

24459 CHEMICAL VALENCE STUDIES IN NUCLEAR DECAY. $^{125}Sn \xrightarrow{\beta} {}^{125}Sb$ REACTION IN K_2 $^{125}SnCl_6$ CRYSTALS. Andersen, T.; Christensen, F.; Olesen, K. (Univ. of Aarhus, Denmark). Trans. Faraday Soc., 62: 248-55(Jan. 1966).

The chemical effects following β-decay of ^{125}Sn in K_2SnCl_6 crystals were investigated. The primary process is $^{125}Sn^{4+} \xrightarrow{\beta} {}^{125}Sb^{5+}$. Secondary processing leading to reduction of $^{125}Sb^{5+}$ plays an important part in crystals containing crystal defects. Post-decay heat treatments show that three reducing reactions occur between 20 and 250°C. The kinetics of the isothermal annealing of ^{125}Sb recoil species were investigated and a model for the reactions is proposed. (auth)

24460 DIFFRACTION SCATTERING OF DEUTERONS BY NUCLEI WITH A WASHED-OUT BORDER. Berezhnoi, Yu. A. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 11: 117-23(Feb. 1966). (In Ukrainian).

The diffraction interaction of deuterons with nuclei characterized by the Gaussian absorption function $\omega(\rho) = ae^{-\rho^2/R^2}$ was investigated. Expressions are obtained for the amplitude of elastic scattering and the integral cross sections of various processes of the interaction of deuterons with nuclei. The behavior of integral cross sections during variation of the parameters a and R is studied. On the basis of the values of a and R, obtained by an analysis of experimental data on the scattering of protons with energy E_p = 313 Mev, estimates are given for the integral cross sections of the elastic scattering σ_e = 103, 1 mb, of the diffraction splitting of the deuteron σ_d = 116.5 mb, of the deuteron absorption σ_a = 80.3 mb during diffraction interaction of deuterons with the nuclei of carbon ^{12}C. A typical feature of diffraction interaction of deuterons with nuclei having a washed-out border is the low value of the cross section of diffraction splitting of the deuteron in comparison with other cross sections. (auth)

24461 COLLECTIVE SINGLE-PARTICLE EXCITATIONS IN EVEN-EVEN NUCLEI WITH A FORM CLOSE TO THE SPHERICAL. Ovcharenko, V. I. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 11: 142-51(Feb. 1966). (In Ukrainian).

The model of a nucleus consisting of a core is considered, the equilibrium form of which differs little from the spherical, and two nucleons interacting with the core and with each other. The results of the calculation show that for even-even nuclei, the form of which is close to the spherical, the consideration of both factors—the small nonspherical equilibrium form of the collective subsystem and unadiabaticity, i.e., the changes of the states of the subsystem of the two outer nucleons in the case of collective excitations—enables, with proper choice of the parameter values, the experimentally observed sequence of low-lying levels and the probability of electric quadrupole transitions between them to be explained. (auth)

24462 SCATTERING OF SPIRAL ELECTRONS IN A COULOMB NUCLEAR FIELD. Kuraev, E. A.; Sannikov, S. S. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 11: 159-62(Feb. 1966). (In Ukrainian).

The processes of elastic scattering, bremsstrahlung, and production of electron-positron pairs by an electron in a Coulomb nuclear field in the region of high energies are considered. The cross section of the production of electron-positron pairs in the limiting case of low energies of the produced pair is determined. (auth)

24463 ON THE USE OF THE Λ^0 HYPERON IN NUCLEAR STRUCTURE STUDIES. EXPERIMENTAL ASPECTS. Sacton, J. Univ. Brux., Inst. Phys., Bull. No. 23, 1-34(Nov. 1965).

Some problems relating to the use of the λ-hyperon for obtaining information about the structure of complex nuclei are discussed. Experimental studies on final state interactions in the decay of light hypernuclei, on excited hypernuclei, and in search for exotic nuclei and hypernuclei are reviewed. (L.B.S.)

24464 A DETERMINATION OF THE B_Λ VALUES OF LIGHT HYPERNUCLEI. Mayeur, C. (Univ. Libre, Brussels); Sacton, J.; Vilain, P.; (and others). Univ. Brux., Inst. Phys., Bull. No. 24, 1-22(Dec. 1965).

Results are presented on the B_Λ values of hypernuclei in the mass range A = 3 to A = 12 obtained from a sample of 595 uniquely identified π^--mesonic decays. The problems of what constitute adequate selection criteria for the unique identification of an event are discussed. The disagreement between the B_Λ values obtained from different decay modes of $_\Lambda H^4$ indicate a possible error in the range-energy relationship. (auth)

24465 INTERNAL CONVERSION ELECTRON SPECTRUM IN THE CAPTURE OF THERMAL NEUTRONS BY GOLD. Bondarenko, V. A.; Prokofev, P. T.; Simonova, L. I. (Inst. of Physics, Academy of Sciences, Latvian SSR). Yadern. Fiz., 3: 193-8(1966). (In Russian).

The spectrum of conversion electrons emitted in the capture of thermal neutrons by ^{197}Au nuclei was investigated on a β-spectrograph with the resolution 0.15–0.3%. The internal conversion coefficients of the transitions were determined by comparing the γ-ray and conversion electron line intensities. The dominating multipolarity of most of the intensive transitions in the energy region 55–300 kev proved to be M1. The low-lying excited levels of ^{198}Au are discussed. (auth)

24466 MULTIPOLARITIES OF THE LOWER TRANSITIONS IN THE ^{176}Lu(n,γ)^{177}Lu REACTION. Balodis, M. K.; Kramer, N. D.; Prokofev, P. T.; Fayner, U. M. (Inst. of Physics, Academy of Sciences, Latvian SSR). Yadern. Fiz., 3: 199-208(1966). (In Russian).

The spectrum of conversion electrons emitted after the capture of thermal neutrons by ^{176}Lu nuclei was investigated. The internal conversion coefficients and transition multipolarities were determined from the relative intensities of the conversion electrons and γ-rays. The decay scheme of ^{177}Lu consists of three rotational bands. The multipolarities of transitions between levels, the spins of which differ by ΔI = 1, belonging to one band, are of the mixed type M1 + E2, and those of transitions with ΔI = 2, of the type E2. The values of the admixture ratio δ^2 for the ground rotational band are near to the theoretical ones. Intensive E2 transitions with the energies 49.7, 111.7, 145.9, and 259.4 kev and the 235.9 kev transition with the multipolarity M1, are not included in the decay scheme. (auth)

24467 MOESSBAUER EFFECT FOR 60.0- AND 86.5-kev γ TRANSITIONS IN ^{155}Gd. Balabanov, A. E.; Delyagin, N. N.; El Saies, Hossein (Moscow State Univ.). Yadern. Fiz., 3: 209-12(1966). (In Russian).

The resonance absorption spectra for 60.0 and 86.5 kev γ-quanta on ^{155}Gd in gadolinium oxide were measured. A ^{155}Eu source in a samarium oxide lattice was used at the temperature 80°K. The width of the absorption line for 86.5 kev γ radiation was determined to be 0.37 ± 0.06 mm/sec, in good agreement with the intrinsic level width, calculated from the known life-time. The width of the 60.0 kev level was found to be 1.4 ± 0.4 mm/sec i.e., $(2.8 \pm 0.8) \cdot 10^{-7}$ ev, which corresponds to the life time $(2.4 \pm 0.7) \cdot 10^{-9}$ sec. This value is larger by about one order of magnitude than the estimation of the lifetime which follows from the existing data on the Coulomb excitation probability of the 60.0 kev level and the M1/E2 ratio for the 60.0 kev γ transition. The probability of the Mössbauer effect for 86.5 kev γ quanta at the temperature 80°K was found to be (1.2 ± 0.2) %, corresponding to the characteristic Debye temperature 191°. (auth)

24468 NATURE OF COMPOUND NUCLEI. Vagradov, G. M. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 3: 213-20(1966). (In Russian).

Field theory methods for many-particle systems are used to investigate the resonance scattering of low-energy nucleons on nuclei. It is shown that the resonance parameters can be expressed with the help of quantities determining the correlation properties of particle systems. Estimations according to the Fermi-liquid theory show that resonances with widths between hundreds of ev and several kev must exist. (auth)

24469 THE GENERALIZED OPTICAL MODEL OF NUCLEI. Rybachenko, V. F.; Meltsas, V. Yu. Yadern. Fiz., 3: 221-6(1966). (In Russian).

The s scattering of neutrons by spin zero nuclei is considered, taking several inelastic scattering channels into account explicitly, so as to clarify the possibility of resonance structures appearing in the elastic and inelastic scattering cross sections in the generalized nuclear optical model. It is shown that resonances in the scattering cross sections, due to the coupling of many channels, can have widths near to the widths of compound nucleus levels. (auth)

24470 THE ACCURACY OF CALCULATIONS OF NUCLEAR COLLECTIVE OSCILLATION FREQUENCIES BY THE u, v-TRANSFORMATION METHOD. Bang, E. M.; Dzholos, R. V.; Markov, A. S.; Mikhailov, I. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 227-33(1966). (In Russian).

The dispersion equation describing octupole oscillations of deformed nuclei is solved numerically. An improved u, v-transformation method, making it possible to calculate approximately mean values of operators between Bardeen functions, projected onto the space of the correct number of particles, is used to find the nuclear quasiparticle spectrum parameters, figuring in the dispersion equation. A simplified method of calculating correlation functions, chemical potentials and two-quasiparticle state energies is described. A calculation of the collective state energies shows, that the modifications due to the account of the projection of Bardeen function onto states with a fixed number of particles and of the blocking, leads to a smoother dependence of the collective oscillation frequencies on A and Z. There are essential changes in the description of nuclei at the beginning of the rare-earth group where zero values of the collective oscillation frequencies were obtained. (auth)

24471 STRUCTURE OF THE COLLECTIVE KINETIC ENERGY IN A SIMPLE MICROSCOPIC NUCLEAR MODEL. Belyaev, S. T.; Rumyantsev, B. A. Yadern. Fiz., 3: 234-44(1966). (In Russian).

The mass parameters of the collective hamiltonian for deformed nuclei are calculated as functions of β and γ and the number of nucleons in the highest unfilled shell, using a model taking pairing and quadrupole interactions in an oscillator potential well into account. The connection between the obtained hamiltonian and the hydrodynamical expression, used in phenomenological methods, is discussed. (auth)

24472 TWO-PARTICLE EXCITATIONS IN NEAR-TO-MAGIC NUCLEI. Mikulinskii, M. A. Yadern. Fiz., 3: 245-51(1966). (In Russian).

The position of the ground and excited levels of nuclei differing from magic ones by two particles (holes), are calculated in the finite Fermi-system theory, taking the coordinate dependence of the interaction amplitude into account. (auth)

24473 COULOMB EFFECTS IN DIRECT NUCLEAR REACTIONS. Dolinskii, E. I.; Mukhamedzhanov, A. M. (Moscow State Univ.). Yadern. Fiz., 3: 252-62(1966). (In Russian).

Methods of taking Coulomb interactions between particles into account in the framework of the direct nuclear reaction theory, using the nonrelativistic diagram techniques to calculate reaction amplitudes, are considered. Some applications of these methods to nuclear reactions are discussed. (auth)

24474 PHOTODISINTEGRATION OF THE ^{9}Be NUCLEUS. Denisov, V. P.; Kulchitskii, L. A. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 3: 268-76(1966). (In Russian).

Reactions of the type (γ,p), (γ,pn), (γ,d) and (γ,t) were investigated. The $^{9}Be(\gamma,p)^{8}Li$ reaction cross section was measured according to the activity of the final nucleus ^{8}Li and to the photoproton spectra for 17 values of $E_{\gamma max}$ between 20 and 50 Mev. This method made it possible to determine the cross sections for transitions to various states of the final nucleus ^{8}Li. The cross sections of the $^{9}Be(\gamma,d)$ and $^{9}Be(\gamma,t)$ reactions were measured. A structure was found in the (γ,p) reaction cross section. The positions of resonances, measured by two different methods, are in good agreement. The total integral cross section of the investigated reactions from the threshold to 40 Mev is equal to 33 ± 3 mb · Mev. (auth)

24475 EXCITATION FUNCTIONS FOR $^{9}Be(\gamma,p)$, $^{9}Be(\gamma,d)$, $^{9}Be(\gamma,t)$, $^{16}O(\gamma,d)$ AND $Cu(\gamma,d)$ REACTIONS EMITTING PARTICLES AT FIXED ENERGIES. Volkov, Yu. M.; Komar, A. P.; Chizhov, V. P. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 3: 277-82(1966). (In Russian).

Differential cross sections are given as functions of the γ-quantum energy for the reactions $^{9}Be(\gamma,p)$, $^{9}Be(\gamma,d)$ and $^{9}Be(\gamma,t)$ accompanied by the emission of particles with the mean energy ~5 Mev, and for the reaction $^{16}O(\gamma,d)$, with the mean energy of deuterons 7.5 Mev. The ratios of the number of deuterons and protons with energies from 3.6 to 5.2 Mev in the photodisintegration of Cu are given. (auth)

24476 INVESTIGATION OF THE $^{15}N(p,\alpha_0)^{12}C$ REACTION WITH POLARIZED PROTONS. Adyasevich, V. P.; Antonenko, V. G.; Kuznetsov, D. A.; Polunin, Yu. P.; Fomenko, D. E. Yadern. Fiz., 3: 290-4(1966). (In Russian).

The energy dependence of the left-right asymmetry of the angular distribution in the $^{15}N(p,\alpha_0)^{12}C$ reaction was measured for polarized protons with energies from 340 to 470 kev. The obtained results are in agreement with the assumed existence of the levels 1^- (E_{res} = 338 kev, Γ = 94 kev) and 2^+ (E_{res} = 1100 ± 100 kev, $\Gamma_p\Gamma\alpha_0 \approx 500$ kev^2) in the compound nucleus ^{16}O. (auth)

24477 INTERACTIONS BETWEEN DEUTERONS AND NUCLEI AT LOW ENERGIES. Komarov, V. V.; Popova, A. M. (Moscow State Univ.). Yadern. Fiz., 3: 295-306 (1966). (In Russian).

Exact integral equations for the reaction amplitudes in the interactions of deuterons with nuclei, having a high-lying first excited state, are obtained, using the method of summing infinite series of nonrelativistic graphs. As an example the reactions between deuterons and α particles are considered. (auth)

24478 THE ASYMMETRY IN THE ANGULAR DISTRIBUTION OF PROTONS FROM THE REACTION $^{12}C(d,p)^{13}C$ USING POLARIZED DEUTERONS. Malko, A. I.; Pucherov, N. N.; Saltykov, L. S. Yadern. Fiz., 3: 307-8(1966). (In Russian).

The asymmetry in the angular distribution of protons from the reaction $^{12}C(d,p)^{13}C$ using polarized deuterons was measured. The results show that it is necessary to take spin-orbital interactions into account. (auth)

24479 DOUBLE CHARGE EXCHANGE OF π MESONS ON Be, C, Al, AND Pb NUCLEI. Batusov, Yu. A.; Bunyatov, S. A.; Sidorov, V. M.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 3: 309-12(1966). (In Russian).

The total cross sections for the double charge exchange in the scattering of 80 Mev mesons (π^+) on Be, Al, and Pb nuclei and 140 Mev mesons (π^-) on Be, C, and Pb nuclei were measured. (auth)

24480 RATIO OF Te ISOMER YIELDS IN THE DISINTEGRATION OF I AND Cs BY 660-Mev PROTONS. Mekhedov, V. N.; Rybakov, V. N.; Sorokin, A. A.; Shtal', M. Z. (Joint Inst. for Nuclear Research, Dubna, USSR. Moscow State Univ.). Yadern. Fiz., 3: 313-15(1966). (In Russian).

The probability ratios for the creation of high- and low-spin states were measured for ^{119}Te and ^{121}Te isomers, obtained in the disintegration of Cs and I by 660 Mev protons. For ^{119}Te these ratios are 0.4 ± 0.03, 0.77 ± 0.07 and for ^{121}Te 0.65 ± 0.07 and 1.1 ± 0.13. (auth)

24481 INVESTIGATION OF THE ENERGY SPECTRA OF NEUTRONS SCATTERED BY ATOMIC NUCLEI BY THE FLIGHT TIME METHOD. Ku, I-fan; Ling, Kuei-chung; Chiang, Wen-mien. Yuan Tzu Neng, No. 7, 581-94(1964).

The inelastic scattering of neutrons scattered from nuclei of ^{6}Li, ^{7}Li, Be, B, C, Fe, and Pb at an angle of 90° to the direction of the incident beam was investigated. Methods based on the flight time were used. (CFSTI)

24482 CIRCULAR POLARIZATION MEASUREMENTS ON ^{86}Rb. Kneissl, U. (Justus-Liebig-Univ., Giessen, Ger.). Z. Naturforsch., 20a: 1364-6(Oct. 1965). (In German).

The polarization of the 1084-kev γ quanta of ^{86}Sr was measured as a function of the β energy at a mean emission angle of 152°. A determination between the two parameter principles of Simms was very difficult because of the relatively small number of β-γ coincidences in proportion to the large number of β transitions at 1777 kev. In spite of the relatively large error, however, the applicability of parameter principle 1 appears probable. Therefore, a result of P_γ = −0.0026 ± 0.023 was obtained in good agreement with previous measurements. (J.S.R.)

24483 THE γ SPECTRUM OF ^{82}Kr. Gfirtner, H.; Reiser, W.; Schneider, H. (Univ., Gissen, Ger.). Z. Naturforsch., 20a: 1727-30(Dec. 1965). (In German).

The γ spectrum of ^{82}Br was measured over a long period of time using a lithium-drifted germanium detector. The γ spectrum obtained is shown and discussed. In addition to previously known γ transitions, transitions were found at 93, 273, 1008, 1777, 1870, and 1955 kev. On the basis of the spectrum obtained a level scheme for ^{82}Kr was proposed. (J.S.R.)

24484 LOW-ENERGY NEUTRON CAPTURE GAMMA SPECTRUM AND LEVEL SCHEME OF ^{168}Er. Koch, H. Ruediger (Technische Hochschule, Munich. Atomenergikommissionens Forsoegsanlaeg, Risoe, Denmark). Z. Phys., 192: 142-61(1966). (In German).

Using the bent crystal gamma-spectrometer in Risø 211 gamma-transitions in ^{168}Er were measured. The low-energy level scheme of this strongly deformed nucleus could be extended considerably. The rotational bands of the ground state and the gamma-vibrational level were found up to I = 8. The negative parity level at 1094 kev must be assigned by I = K = 4 and is expected to be mostly the [521↓ + 633↑] two quasineutron state. The corresponding rotational band was built up including the I = 8 level. The I = K = 3 negative parity level at 1541 kev represents very probably the [521↓ − 633↑] two quasineutron state. Its rotational band was found up to the I = 7 level. The calculation of mixing ratios of intraband transitions yields $|G_{44}| < 0.2$ and $G_{33} = -1.85$ nuclear magnetons for the parameters of the M1-transition probability within the K = 4 and the K = 3 band. The γ-transitions between these bands are well explained assuming Coriolis coupling. The band mixing is calculated from intensity ratios. (auth)

24485 MEASUREMENT OF CIRCULAR POLARIZATION OF 478-kev GAMMA QUANTA FROM THE REACTION ^{6}Li(d,p)^{7}Li WITH 2-Mev DEUTERONS. Schuler, W. (Technische Hochschule, Karlsruhe, Ger. Kernforschungszentrums, Karlsruhe, Ger.). Z. Phys., 192: 173-81(1966). (In German).

The circular polarization P_γ of 478-kev γ quanta from the reaction ^{6}Li(d,pγ)^{7}Li with 2-Mev deuterons was measured by forward Compton scattering from magnetized iron. The protons were observed at 25° lab angle. The fast neutron background in the γ detector was suppressed by pulse shape discrimination. The result $P_\gamma = +0.022 \pm 0.17$ with the Basel sign convention confines the ratio of the reduced widths $\Theta_\pm$ for the capture of the neutron with $j = l \pm \frac{1}{2}$ to the regions $-2.36 \leqq \Theta_+/\Theta_- \leqq -0.74$ or $-0.06 \leqq \Theta_+/\Theta_- \leqq +0.61$. (auth)

24486 THEORY OF GIANT RESONANCE IN SPHERICAL gg NUCLEI. I. COUPLINGS OF DIPOLE AND QUADRUPOLE VIBRATIONS. Weber, Hans. J.; Huber, Max G.; Greiner, Walter (Univ., Frankfurt am Main). Z. Phys., 192: 182-222(1966). (In German).

The dynamic collective theory of Danos and Greiner was extended to spherical nuclei. For the coupling of giant resonances with surface quadrupole-vibrations a systematical theory is developed by computing the dipole-quadrupole interaction $K_1(\alpha_2\alpha_1\alpha_1)_0 + K_0(\alpha_2\alpha_2)_0(\alpha_1\alpha_1)_0 + K_2((\alpha_2\alpha_2)_2(\alpha_1\alpha_1)_2)_0$. The dipole-quadrupole hamiltonian is solved by establishing the energy matrix with the 1-dipole-many-quadrupole phonon states as a basis. (auth)

24487 LA CHIMIE NUCLEAIRE. ETUDE DES NOYAUX RADIOACTIFS ET DES REACTIONS NUCLEAIRES. (Nuclear Chemistry. Study of Radioactive Nuclei and Nuclear Reactions). Lefort, Marc. Paris, Dunod, 1966. 525p.

A study of the structure of stable and unstable nuclei and of nuclear reactions and reaction mechanisms is presented. Discussions are given of radioactivity; the natural and artificial radionuclides; alpha and beta decay, neutron and proton emission, gamma de-excitation, and spontaneous fission; reaction cross sections, nuclear kinematics, and Coulomb scattering; compound-nucleus reactions; high-energy spallation reactions and direct interactions followed by evaporation; reactions involving direct transfer of nucleons or nucleon groups; low- and high-energy fission. Experimental methods for initiating reactions and studying reaction products are considered, and various types of accelerators, radiation detectors, and analytical techniques are described. Applications of nuclear chemistry are discussed, including the Szilard-Chalmers and Mössbauer effects, synthesis of new elements and activation analysis, nuclear reactors, and cosmology and cosmic radiation. (M.J.T.)

Plasma Physics and Thermonuclear Processes

See also Fluid Physics and Thermodynamics

Refer also to abstracts 23900, 24196, 24584, and 24608.

24488 (AE-218) MEASUREMENT OF THE ELECTRICAL CONDUCTIVITY OF ^{3}He PLASMA INDUCED BY NEUTRON IRRADIATION. Braun, J.; Nygaard, K. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Mar. 1966. 37p. Dep. mn.

The conductivity of a ^{3}He plasma created by the inelastic reaction with thermal neutrons $^3He + n_{th} \rightarrow {}^3H + p + 0.76$ Mev is studied as a function of neutron flux, gas temperature and gas density. Using reported values of the electron mobility the electron density is calculated from experimental conductivity values. Further, by accepting a reasonable value for the mean energy lost in creating one ion-pair, the recombination coefficient is estimated. The measurements performed so far cover temperatures between 300–1600°K and densities between 0.25–1 times the density at atmospheric pressure and 300°K. The neutron flux is varied between 10^{10}–10^{11} n cm^{-2} s^{-1}. (auth)

24489 (AD-624486) RESEARCH IN HIGH-TEMPERATURE PLASMAS FOR SPACE APPLICATIONS. VOLUME II. ENGINEERING. Annual Report. Luce, John S. (Aerojet-General Nucleonics, San Ramon, Calif.). Oct. 1964. Contract AF33(657)-11183. 397p. (AN-1225 (Vol.2); APL-TDR-64-124(Vol.2)). CFSTI $7.00 cy, $1.75 mn.

An engineering analysis of a mirror-cusp magnetic bottle for experiments in plasma physics was performed. Heat transfer, pressure drop, and mechanical stresses were studied. A design with a safety factor of 3 to yield, except for the axial coil winding which has a safety factor of 2.2 to yield, was obtained. (D.C.W.)

24490 (AD-624927) BASIC PLASMA PROCESSES. Final Research Report, November 16, 1964–November 15, 1965. Phelps, A. V.; Chen, C. L. (Westinghouse Research Labs., Pittsburgh, Pa.). Dec. 7, 1965. Contract Nonr-4725(00). 33p. CFSTI $2.00 cy, $0.50 mn.

An experimental arrangement for the study of cesium-seeded, helium plasmas at high temperatures is described. This system is to be used for the study of nonequilibrium ionization and Hall coefficients in these plasmas. A description is given of an experiment being constructed for the study of the reflection and transmission characteristics of cesium resonance radiation. The high-temperature brazing technology of polycrystalline alumina (PCA) to metal, PCA to sapphire, and metal to metal was also studied briefly. (TAB)

24491 (AD-625897) UNIFIED APPROACH TO EXCITATION PROBLEMS IN COMPRESSIBLE PLASMA. Summary Report. Wu, Y.-K. (Michigan Univ., Ann Arbor. Radiation Lab.). Nov. 1965. Contract AF30(602)-3381. 227p. (RADC-TR-65-353). CFSTI $6.00 cy, $1.25 mn.

This investigation is concerned primarily with the general, unified approach to the solution of excitation problems in a compressible plasma which may be inhomogeneous and include different types of sources. The Maxwell-Euler equations are reformulated through linear operator and generalized transform techniques into an equivalent matrix integral equation, which can be solved recursively for a general linear plasma medium. When the medium is homogeneous, this integral equation has a degenerate kernel and the explicit solution can be easily obtained. A thorough study is given for the excitation of disturbances due to different types of sources in a homogeneous electron plasma externally impressed by a constant magnetic field. The dispersion relations for the three types of waves involved in an electron plasma are studied carefully and a proper terminology introduced. The radiation field is then solved for both two- and three-dimensional excitation problems. Equivalence relations between different types of sources are also obtained. The numerical result shows that a large portion of energy radiation is in an acoustic type wave. (auth)

24492 (AD-626144) SURFACE WAVES AT A PLANE INTERFACE BETWEEN VACUUM AND PLASMA WITH THE MAGNETOSTATIC FIELD NORMAL TO THE INTERFACE. Physical Sciences Research Paper. Sivaprasad, Kondagunta U.; Seshadri, Sengadu R. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Oct. 1965. 30p. (AFCRL-65-753). CFSTI $2.00 cy, $0.50 mn.

The characteristics of the surface waves sustained by a plane interface which separates semi-infinite regions of vacuum and magnetoionic medium are investigated for the case in which the magnetostatic field is normal to the interface. It is found that plane surface waves exist if the gyromagnetic frequency is less than the plasma frequency and in the range of frequencies lying between the gyromagnetic frequency and $1/\sqrt{2}$ times the upper hybrid resonant frequency. The phase velocity of the surface waves is always less than the velocity of electromagnetic waves in free space and it decreases monotonically with the increase in the frequency and goes to zero at $1/\sqrt{2}$ times the upper hybrid resonant frequency. (auth)

24493 (AD-627267) MICROWAVE DETERMINATION OF ANISOTROPIC PLASMA ELECTRON DENSITY PROFILES. Warder, R. C.; Hector, D. L. (Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.). Aug. 1965. Contracts AF-AFOSR-62-307; AF-AFOSR-329-63. 152p. (AFOSR-65-2215). CFSTI $5.00 cy, $1.00 mn.

A method for the determination of the spatial electron density distribution in plasmas subjected to external magnetic fields is presented. The method involves the measurement of the Faraday rotation angle as a function of the external magnetic field strength. Results of calculations of normalized Faraday rotation angle versus normalized electron cyclotron frequency for various assumed electron density distributions are given. (auth)

24494 (AD-627530) NONLINEAR ANALYSIS OF A MICROWAVE BEAM-PLASMA AMPLIFIER. Genine, Bo (Chalmers Tekniska Hogskola, Goteborg (Sweden). Forskningslaboratorium for Elektronik). Aug. 1, 1965. Contract AF61(052)-594. 45p. (TN-6; RADC-TR-66-28). CFSTI $2.00 cy, $0.50 mn.

The linear and nonlinear field theory of an idealized, radially finite beam-plasma amplifier model is discussed. Both the beam and the plasma are assumed to be made up of infinitesimal, rigid, circular discs with a charge to mass ratio equal to that of the electron. Radial motions and finite temperature effects are not considered. Thus the main purpose of the theory, which is purely analytical, is to describe as simply as possible the effect of finite radial boundaries upon the basic linear and nonlinear properties of beam-plasma devices. Linear amplification and bandwidth, non-linear generation of second and third harmonic signals and distortion of the fundamental are studied. (auth)

24495 (AD-627614) RECOMBINATION RATES FOR He^{2+} IONS: A REPLY TO "COMMENTS ON DEVIATIONS FROM IONIZATION EQUILIBRIUM IN PLASMAS GENERATED BY ELECTRIC SHOCK TUBES." Kerr, Donald E.; Isler, Ralph C. (Johns Hopkins Univ., Baltimore, Md. Dept. of Physics). Jan. 1966. Contract Nonr-4010(10). 23p. (TR-2). CFSTI $1.00 cy, $0.50 mn.

In support of earlier work on deviations from ionization equilibrium in helium plasmas generated by electric shock tubes, further experimental data and calculations, including some of characteristic recombinations times are presented. (TAB)

24496 (AD-627681) CYCLOTRON ECHO PHENOMENA. Gould, Roy W. (California Inst. of Tech., Pasadena). Dec. 1965. Contract Nonr-220(50). 34p. (TR-28). CFSTI $2.00 cy, $0.50 mn.

Experimental observations and theories of pulse stimulated radiation phenomena in plasmas are reviewed. The motions of an ensemble of non-interacting electrons in a magnetic field are considered and it is shown that cyclotron echoes in plasmas can arise out of various types of nonlinearities: (a) energy dependent electron cyclotron frequency, (b) energy dependent electron collision frequency, (c) energy dependent driving force. The similarities and differences with spin and photon echoes are discussed, and several new related phenomena are also described. (auth)

24497 (AD-628004) CONSOLIDATED QUARTERLY PROGRESS REPORT ON PLASMA RESEARCH. Quarterly Progress Report No. 1, January 1-March 31, 1965. Report No. 112. (California Univ., Berkeley. Electronics Research Lab.). Contract AF33(615)-1078. 42p. (AFOSR-65-2301). CFSTI $2.00 cy, $0.50 mn.

Research is included on: plasma diagnostics with a laser; synchrotron radiation measurements; weakly stabilized mirror machine of the mirror-quadrupole type; electron cyclotron heating; plasma instability experiment; stability of hollow plasmas; computer model for nonlinear investigation of plasma interchange instability; damping and instabilities of cyclotron waves in a plasma; automatic data processing; instabilities of centrifugal electrostatic focused flow; r-f ion source for an ion energy analyzer; electron cyclotron heating in magnetic mirror machines. (TAB)

24498 (AD-628018) NON-LINEAR THEORY OF PLASMA DYNAMICS. Final Technical Report, February 1, 1964-January 31, 1965. Aamodt, R. E. (General Atomic, San Diego, Calif.). Mar. 1, 1965. Contract AF49(638)-1356. 38p. (GA-6179). CFSTI $2.00 cy, $0.50 mn.

The effects of the nonlinear process of resonant wave-wave scattering for unstable modes in a homogeneous plasma system with a constant external magnetic field are evaluated. It is shown that this particular nonlinear mechanism may provide a partial explanation of some existing experimental results, and in addition, provides an experiment to verify the nonlinear theory. (auth)

24499 (AD-628029) OHM'S LAW IN MULTICOMPONENT NON-ISOTHERMAL PLASMAS WITH TEMPERATURE AND PRESSURE GRADIENTS. Final Report. Demetriades, Sterge T.; Argyropoulos, George S. (STD Research Corp., Pasadena, Calif.). Sept. 1965. Contract AF49(638)-1445. 91p. (AFOSR-66-0004). CFSTI $5.00 cy, $1.00 mn.

A closed set of transport equations with collision terms that were evaluated by the 13-moment approximation is used, under well-defined assumptions, to derive a generalized Ohm's Law in multicomponent non-isothermal plasmas as a function of the electric and magnetic fields and the temperature and pressure gradients. The nine coefficients defining this dependence are expressed in matrix form in terms of component properties for any number N of components in the plasma, each component having its own temperature. The matrix expressions are evaluated in detail for four- and five-component plasmas (N = 4,5); this allows the investigation of effects that cannot be studied with the available three-fluid expressions. (TAB)

24500 (AD-622815) MEGATRON ACCELERATOR. Final Report, April 15, 1961-June 15, 1964. Rogers, K. C.; Lukasik, S. J.; Ferrari, L. (Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics). Contract DA-36-039SC-87242E. 242p. (SIT-P-147(5/65)). CFSTI $6.00 cy, $1.25 mn.

The Megatron (plasma betatron) Project is discussed. Construction details of the accelerator are given, and methods of shaping and measuring the magnetic guide field are described. Methods of generating the plasma and its initial properties are listed. Application of the time-varying magnetic guide field results in the production of a runaway electron beam of peak energy 1 Mev and beam intensity approximately one ampere. Methods of detecting the runaway electrons are described, and the electron life histories are studied. It is found that ultimate destruction of the runaway electron beam results from a collective interaction of the beam electrons and the background plasma. The observations are compared with theoretical results of Field and Fried. Also included are the results of a computer study of early time collective effects in a cold plasma subjected to a rapidly rising betatron guide field. (auth)

24501 (IPPJ-45) STABILITY OF A UNIFORM PLASMA COMPOSED OF STREAMS IN THE ABSENCE OF AN EXTERNAL FIELD. Momota, Hiromu (Institute of Plasma Physics, Univ. of Nagoya (Japan)). Feb. 1966. 22p. Dep. mn.

By means of the collisionless Boltzmann equation and the Maxwell equations with no external field, it is shown that a plasma composed of streams is necessarily unstable for a transverse oscillation propagating perpendicularly to the streams. The instability is attributed to the bunching of the electric current density, corresponding to the bunching of the charge density in the usual two-stream instability which is accompanied by the excitation of a longitudinal oscillation. When the thermal motion of the particles in a stream is taken into account, the instability can be suppressed due to the thermal diffusion of the bunched current. For a transverse oscillation, a criterion of the stability is obtained. (auth)

24502 (IPPJ-46) TRANSMISSION AND ABSORPTION OF ELECTROMAGNETIC WAVES IN A COLLISIONLESS PLASMA SLAB. Sugihara, Ryo (Institute of Plasma

Physics, Univ. of Nagoya (Japan)). Feb. 1966. 29p. Dep. mn.

An investigation is made of the propagation of electromagnetic waves normal to a plasma slab with a density gradient. The plane of polarization of the waves is perpendicular to an external magnetic field. At resonances, a WKB-type approximation does not represent the waves, and an appreciable absorption appears due to infinitesimal collisions. The transmission and absorption coefficients are obtained in the limit of no collisions for the case in which the cut-off is adjacent to the resonance. (auth)

24503 (IPPJ–48) RESONANCES OF RADIO-FREQUENCY PROBE IN A PLASMA. Ikezi, Hiroyuki; Takayama, Kazuo (Institute of Plasma Physics, Univ. of Nagoya (Japan)). Mar. 1966. 23p. Dep. mn.

An r-f probe experiment was carried out by the use of a low-density plasma, and resonances of the probe impedance were studied. Two resonances were observed in a frequency range between the sheath-plasma resonance and the plasma frequencies. A mechanism for the additional resonances is discussed. It is shown that finite electron temperature introduces resonances in addition to the sheath-plasma resonance. Choosing some artificial density distributions in front of the probe, the frequency dependence of the resonances is explained qualitatively. (auth)

24504 (JAERI–1999) EXPERIMENTS ON THE PLASMA FLOW PAST BODIES IN A MAGNETIC FIELD. [PART] I. Kawashima, Nobuki; Mori, Sigeru (Japan Atomic Energy Research Inst., Ibaraki. Thermonuclear Research Lab.). July 1965. 26p. Dep. mn.

Plasma flows past bodies in a magnetic field are investigated experimentally by the use of a plasma from a plasma gun. The downstream wake of an ordinary hydrodynamic shock wave is observed for a collision-dominant plasma flow. When the body in the plasma flow is a wedge-shaped conductor, the structure of the shock is investigated in detail. The plasma flow is divided into four regions by three characteristic lines; (1) the shock front, (2) the separation line of the shock wave from the tail of the wedge, and (3) the magnetic line of force passing through the tail of the wedge. When a wake of the shock wave interacts with the other wake, they join along the magnetic lines of force. Plasma flows past a wave-shaped wall are also investigated. As the plasma flow becomes collision-free, this downstream wake gradually disappears and no collision-free shock wave is observed. When the plasma flow is sub-Alfvenic, a disturbance propagating upstream along the magnetic lines of force is observed. (auth)

24505 (N–65–14949) A GEOMETRICAL REPRESENTATION FOR THE HIGH-FREQUENCY DIELECTRIC TENSOR OF A TEMPERATE PLASMA. Brooks, Sidney (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jan. 1965. 7p. (NASA-TM–X-1054). CFSTI $1.00 cy, $0.50 mn.

A geometrical representation for the h-f dielectric tensor of a temperate plasma is given. It is simple in form and readily shows the effect of varying the plasma parameters. (STAR)

24506 (N–65–33116) INVESTIGATION OF THE HIGH-PRESSURE HELIUM ARC PLASMA BY MICROWAVE CAVITY TECHNIQUES. Maloney, William T. (Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.). June 1965. 34p. (TR–17).

A steady-state atmospheric pressure helium-arc plasma flowing through a 1 cm circular copper pipe at a flow of 7240 ml/min was studied by microwave cavity diagnostic techniques. The measurement of a microwave cavity resonant frequency is interpreted as a measurement of the diameter of the plasma column. The diameters, however, exhibit a transient and an irreproducibility in final values which is attributable to contamination of the arc. The effects on the arc current of adding controlled amounts of argon and nitrogen to the arc show that levels of a few parts per million produce significant dilation of the column. This dilation is attributed to seeding with electrons by gases having ionization potentials less than that of helium. At higher contaminant levels, nitrogen produces a contraction of the column. It is concluded that the microwave cavity technique provides an extremely sensitive monitor of the state of gas purity. (STAR)

24507 (N–66–15346) NONLINEAR TECHNIQUE FOR PLASMA DIAGNOSTICS. Scientific Report No. 3. Zachary, W. W. (Electromagnetic Research Corp., College Park, Md.). Nov. 30, 1965. Contract NASw-835. 5p. (NASA-CR–69290). CFSTI $4.00 cy, $0.75 mn.

A technique for plasma diagnostics is described which uses the nonlinear properties of the plasma medium. The situation is considered in which two electromagnetic fields with different frequencies, ω_1 and ω_2, are externally applied to a plasma. Detailed calculations are carried out for the cases of wave propagation parallel and perpendicular to a static magnetic field. The most promising results, for the purposes of plasma diagnostics, are found in the case of perpendicular propagation. If the work presented is extended to include wave propagation directions at any arbitrary angle with respect to the static magnetic field, the corresponding currents will depend on the longitudinal as well as the transverse temperature. It is hoped that the longitudinal temperature can also be measured in this way. This extension is straightforward in principle, involving only more tedious calculations. Since there are two resonance conditions in the case discussed, a frequency sweep technique is suggested for measurements of electron temperatures in the ionosphere. (STAR)

24508 (N–66–15390) A STUDY OF THE THEORY AND MEASUREMENT OF PLASMA DIFFUSION [Thesis]. Otteni, Gerald A. (Case Inst. of Tech., Cleveland, Ohio). Apr. 1965. 89p. (NASA-CR–69343; A–35). CFSTI $3.00 cy, $0.75 mn.

A basic introduction to the theory of plasma diffusion is given with references to previous papers in this area. Emphasis is placed on characterizing the diffusion by dyadic diffusion coefficients so that diffusion in the presence of magnetic fields can be included. In the theory, only attachment, ionization, and diffusion mechanisms are assumed to exist in the plasma. Solutions are given for plasma distributions in rectangular and cylindrical geometries. An experiment is described which allows the plasma properties to be measured by reflection of a dominant TE_{10} rectangular waveguide mode from a decaying plasma distribution which partially fills the waveguide. Preliminary results in the absence of a magnetic field indicate the presence of a number of resonances in the plasma slab. (STAR)

24509 (N–66–15427) COLLISIONAL INTERACTIONS OF ENERGETIC TEST ELECTRONS WITH A PLASMA. Smith, Michael R. (Case Inst. of Tech., Cleveland, Ohio). July 1965. 96p. (NASA-CR–68537; A–39). CFSTI $3.00 cy, $0.75 mn.

An expression for the energy loss rate of an energetic test electron traversing a plasma is derived from a binary collision viewpoint. The energy loss due to the excitation of plasma oscillation is included through an ad hoc extension of the maximum impact parameter, $\lambda_D(V/W_t)$. The solution is generalized to include the effect of a translating plasma. An expression for the distribution of energy losses of a beam of monoenergetic test electrons traversing a finite plasma is obtained through the solution of a Boltzman equation. The transmission of the beam is calculated using multiple scattering theory. Various aspects of the electron-electron collision problem are discussed. (STAR)

24510 (N–66–15440) PROPAGATION OF ION ACOUSTIC WAVES ALONG CYLINDRICAL PLASMA COLUMNS. Wong, A. Y. (California Univ., Los Angeles. Plasma Physics Group). July 1965. 7p. (NASA-CR–69387; R–1). CFSTI $1.00 cy, $0.50 mn.

Transverse boundary conditions are considered important if the ion cyclotron radius, rather than the wave-

length of the ion wave, is comparable to the plasma radius. Examination indicates that the transverse boundary effects on ion-acoustic waves can be weakened by the application of a sufficiently high magnetic field which reduces the boundary contribution with respect to the electron contribution in ion acoustic waves. Longitudinal electron plasma oscillations are sensitively dependent upon the boundary conditions since the corresponding ion contribution to the electron oscillations is zero. The independence of ion-acoustic waves on transverse boundary conditions can be shown under typical laboratory conditions. (STAR)

24511 (N-66-15441) STABILITY LIMITS FOR LONGITUDINAL WAVES IN ION BEAM-PLASMA INTERACTION. Fried, Burton D.; Wong, Alfred Y. (California Univ., Los Angeles. Plasma Physics Group). Aug. 1965. 31p. (NASA-CR-69377; R-2; STL-9801-6015-RU-000). CFSTI $2.00 cy, $0.50 mn.

The two-stream instability is examined for the case of an ion beam traversing a plasma. The dispersion equation for linearized, longitudinal waves in a plasma where collisions are negligible is used to find the restrictions on beam velocity, temperature, and density which will lead to growing waves. (STAR)

24512 (N-66-15979) BIOMODAL-CAVITY MEASUREMENT OF THE MICROWAVE FARADAY EFFECT IN A GASEOUS MAGNETOPLASMA [Thesis]. Technical Report No. 2. Raiford, M. T. (College of William and Mary, Williamsburg, Va. Plasma Physics Lab.). June 1963. 54p. (NASA-CR-69655). CFSTI $3.00 cy, $0.50 mn.

Faraday rotation of microwaves in a magnetized plasma was observed using a microwave-cavity technique. The positive column of a gaseous discharge was placed coaxially within a cylindrical cavity, with a magnetic field applied along this same axis. The cavity was excited in the angularly dependent TE_{111} mode, which is doubly degenerate, at a frequency in the neighborhood of 2000 Mc. An input antenna was coupled to one of the degenerate modes, and an orthogonal output antenna was coupled to the other mode. Theory shows that the power coupled to the output is proportional to the absolute square of the off-diagonal element of the conductivity tensor of the anisotropic plasma. This gives a curve of output power as a function of magnetic field which is strongly dependent on collision frequency and also dependent on electron density. (STAR)

24513 (TID-22735, pp 83-98) PLASMA PHYSICS. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Research on the fundamental properties of plasmas is summarized. Emphasis was placed on plasmas in magnetic fields, highly ionized low-pressure plasmas, and plasma turbulence in high-speed flow. Studies of microwave radiation from plasmas with and without magnetic fields are described along with theoretical studies of waves in plasmas, turbulence in flowing gases, and plasma statistics. (J.R.D.)

24514 (TID-22735, pp 99-108) GASEOUS ELECTRONICS. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Fundamental particle interactions in plasma were investigated. Emphasis was placed on measuring particle diffusion coefficients, collision probabilities in ionized gases, and on radiation production mechanisms. Information is included on time-dependent electron velocity distribution functions, and radiofrequency dipole resonance probes. (J.R.D.)

24515 (TID-22735, pp 159-61) SPONTANEOUS RADIOFREQUENCY EMISSION FROM HOT ELECTRON PLASMAS. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Research on instabilities in neutral unbounded magnetized plasma is described. (J.R.D.)

24516 (UCID-5036) THE MAGNETIC PULSE IN A COLD COLLISION-FREE PLASMA. Gonzales, D. E.; Zwick, S. A. (Lawrence Radiation Lab., Univ. of California, Livermore). Mar. 1965. Contract W-7405-eng-48. 21p. (CONF-651126-11). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, 7th Annual Meeting of the Division of Plasma Physics, San Francisco.

The steady-state motion of a magnetic disturbance propagating transverse to a uniform magnetic field in a cold collision-free plasma is investigated. Electrostatic interactions are ruled out by assuming that the plasma constituents have equal mass. The disturbance consists of either a pulse or an infinite sequence of pulses of extra magnetic flux parallel to the original flux. Each flux perturbation has the net effect of displacing the entire plasma along the direction of propagation. (auth)

24517 PLASMA PROPERTIES BY SPECTROSCOPIC MEASUREMENTS. Wilsted, H. D.; Woerner, Wolfgang. Allison Res. Eng., 9: 2-17(First Quarter 1966).

A summary of spectrographic measurements of plasma properties in direct conversion devices and a cesiated helium arc is presented. The line reversal technique was used to measure the electron temperature in a magneto-plasmadynamic (MPD) generator and appeared to give good results; accuracies should be within ±75°K. Both the absolute intensity and relative line intensity methods were used to measure electron temperature in a thermionic generator. The absolute line intensity technique was excellent in that it provides a high sensitivity except at near peak line intensity conditions. There are, however, inherent in this method the uncertainties in the accuracy of the transition probabilities. Data scatter in the relative line intensity method made it difficult to use and the accuracy was seriously in doubt. The differential line ratio method eliminates the need for transition probabilities, spectral calibration of the photographic plate, and use of a radiation standard. Although it has not been used extensively to date, it can be concluded that it is relatively easy to use and should improve the accuracy of electron temperature measurements. (auth)

24518 PLASMA DENSITY MEASUREMENTS AT 100 KILOBARS OF PRESSURE. Robinson, James W. (Univ. of Michigan, Ann Arbor). Appl. Phys. Lett., 8: 207-8 (Apr. 15, 1966).

Experiments are described in which pressures of 100 kilobars were established in an underwater electric discharge by the detonation of a few grams of a chemical explosive near the discharge path. At 100 kilobars, the plasma formed by the discharge has the density of a solid without the regularity of a lattice, and strong particle interactions have a very significant effect upon the properties of the plasma. Quantitative thermodynamic data were obtained. (L.B.S.)

24519 ELECTRICAL AND MECHANICAL CHARACTERISTICS OF T.A. 2000. Cano, R.; Fairclough, C. G.; Sledziewski, Z.; Taquet, B.; Torossian, A. Bull. Inform. Sci. Tech. (Paris), No. 101, 21-5(Feb. 1966). (In French).

A short account of the main mechanical and electric parameters of T.A. 2000, an annular discharge device in an aluminum torus having a 2-meter diameter and 30-cm bore is given. The inside liner which is made of stainless steel has an electric resistance of 8×10^{-2} Ω. The discharge is produced with a 90-kilojoules condenser bank; it carries a current of 215 kamp at maximum. The half period is 320 μs. (auth)

24520 MAGNETIC PROBE EXPERIMENTS IN T.A. 2000. Cano, R.; Fairclough, C. G. Bull. Inform. Sci. Tech. (Paris), No. 101, 27-33(Feb. 1966). (In French).

A description is given of the magnetic probe technique used for drawing up the field map of the T.A. 2000 discharge as a function of time. From this is deduced the current distribution and the value of the electric resistivity. The resistivity value observed is higher than that deduced using Spitzer's formula. This abnormal resistance phenomenon becomes more pronounced when the probe rod is introduced. (auth)

24521 X RADIATION FROM T.A. 2000. Etievant, C. Bull. Inform. Sci. Tech. (Paris), No. 101, 35-7(Feb. 1966). (In French).

A penetrating x radiation is emitted during the breakdown of the discharges in T.A. 2000. A number of experimental observations lead to the conclusion that this radiation is related to the acceleration of electrons by a betatron effect. (auth)

24522 INFRARED EMISSION AND ELECTRICAL RESISTIVITY MEASUREMENTS OF THE PLASMA IN T.A. 2000. Cano, R.; Mattioli, M. Bull. Inform. Sci. Tech. (Paris), No. 101, 39-41(Feb. 1966). (In French).

An interference spectrometer using an indium antimonide detector in liquid helium was used for studying the infrared radiation emitted by the plasma in T.A. 2000. These measurements make it possible to evaluate the density of the plasma as well as the electron temperature. For the fairly high filling pressures used in these experiments, the agreement with the electron temperature deduced from electric resistivity measurements is fairly good. (auth)

24523 SPECTROSCOPY STUDIES ON THE T.A. 2000. Breton, C.; Platz, P.; Schwob, J. L. Bull. Inform. Sci. Tech. (Paris), No. 101, 43-69(Feb. 1966). (In French).

The time variation of spectral line intensities is interpreted in terms of a model describing the ionization of hydrogen and impurities as a function of time. A method for electron temperature measurement is deduced. Using line intensity ratios for the lithium isoelectronic sequence ($N4^+$) a second method is developed. The electron temperature varies from 8 ev at the beginning of the discharge to 100 ev at 100 μs. The ion temperature, from Doppler line broadening, increases faster, up to 150 ev at 120 μs. An approximative energy balance shows considerable abnormal losses. (auth)

24524 DIFFUSION AND INSTABILITIES. Bernard, M.; Briffod, G.; Frank, R.; Gregoire, M.; Weisse, J. Bull. Inform. Sci. Tech. (Paris), No. 102, 11-20(Mar. 1966). (In French).

The scattering of particles across the lines of force of the magnetic field depends on the fluctuations present in the plasma. Two particular types of instabilities liable to cause and sustain these fluctuations are considered. The first type of instability results from a resonance in the energy exchange between the waves and the particles. This has been shown to exist in plasmas obtained from beams or from low pressure discharges, and has been studied in certain installations (Reflex-Iris). The second type is that of drift instabilities. It is connected with the presence of inhomogeneities which are sometimes dominant. The conditions necessary for a study of these instabilities are found in the installation DAPHNIS. (auth)

24525 ION BEAMS AND SYNTHETIC PLASMAS. Bonnal, J. F.; Giacomini, J.; Mainfray, G.; Manus, C.; Morellec, J.; Spiess, G. Bull. Inform. Sci. Tech. (Paris), No. 102, 21-33(Mar. 1966). (In French).

A description is given of the creation of a plasma fulfilling the following conditions: stability, negligible collisions between electrons and neutral particles and ions and neutral particles, absence of magnetic and electric fields, possibility of varying the parameters independently of each other. The obtention of this plasma experimentally from an ion beam is studied. The operational conditions for the ion source are reviewed and a detailed analysis is made of the problem of the neutralization of the beam by injection of thermionic electrons. By deliberately applying perturbations, it is possible to make a very general analysis of the influence of these perturbations on the behavior of a plasma. An example is given, which shows how instabilities of the beam-plasma type occur when a longitudinal electric field is applied. Synthetic plasma is a very suitable medium for studying certain general aspects of plasma physics instabilities, wave damping, etc. (auth)

24526 H.F. FIELDS AND PLASMA ACCELERATORS. Consoli, T. Bull. Inform. Sci. Tech. (Paris), No. 102, 35-48(Mar. 1966). (In French).

The results of theoretical and experimental work on the use of static magnetic and h-f field gradient combinations for the acceleration, reflection, and accumulation of plasma are presented and discussed. Three experimental devices (PLEIADE, CIRCE and ICARE) are described, which were built with a view to verifying the theoretical predictions, and also give the measurement methods. The objectives which are sought after with these various pieces of equipment, intended for checking similitude laws, are always the same: to compare the steady h-f field states with the varying field states; to make it possible to inject an energetic plasma axially into a magnetic bottle, to suppress losses due to the reflections; to confine the plasma that has been accumulated by continuous or pulsed injection. Finally the experimental results obtained in the asymmetrical state (one single injector) and in the symmetrical state (injector + reflector), with either steady h-f fields or damped variable fields are described. (auth)

24527 DEVELOPMENT OF HIGH-POWER GENERATORS FOR THE PRODUCTION OF OSCILLATING FIELDS. Consoli, T.; Le Gardeur, R. Bull. Inform. Sci. Tech. (Paris), No. 102, 49-59(Mar. 1966). (In French).

The low (1–10 MHz) and high (10^3 to 10^4 MHz) frequency oscillating fields of very high power (greater than one megawatt for long pulses > 100 μs) are of considerable interest for the heating, acceleration, confinement and stabilization of plasma. Four oscillating field generators (plasma magnetron, plasma switch, cyclotron resonance cavity, wide-band L band klystron) are described, which are being studied or which are already in the prototype stage at the French Atomic Energy Commission Saclay Centre. These generators have been developed with a view to studying the interaction of oscillating fields with a plasma. (auth)

24528 PRODUCTION OF BURSTS OF DENSE PLASMA BY FOCALIZATION OF A LASER BEAM ON TARGET. Consoli, T.; Gormezano, C.; Slama, L. Bull. Inform. Sci. Tech. (Paris), No. 102, 61-8(Mar. 1966). (In French).

A description is given of the production of bursts of neutral or ionized gas by the focussing of a beam of coherent light emitted by a ruby laser into a target made either of pure metal or of metal containing a gas. These bursts, for which the determination of the physical characteristics is described, can be used for a very high speed pre-ionization of strong electron or ion sources, in particular when they are subjected to a strong acceleration which displaces the limits given by the Child-Langmuir law. (auth)

24529 PRESENT STATE OF PLASMA DIAGNOSIS METHODS NOW IN USE IN THE APPLIED PHYSICS SERVICES. Consoli, T.; Lepechinsky, D.; Rolland, P.; (and others). Bull. Inform. Sci. Tech. (Paris), No. 102, 69-98 (Mar. 1966). (In French).

Certain methods used for plasma diagnosis are described, which have been developed by the Applied Physics Services at Saclay. These include: low density measurements using resonance probes; hyperfrequency measurements; diagnosis with luminous sources using ruby and gas laser beams; radiometry; electro-optics; and polarized pyrometric probe. (auth)

24530 RESEARCH TREND ON IONIZED GAS IN ELECTROMAGNETIC FIELD. Murasaki, Toshimitsu (Osaka Univ.). Bull. Inst. Space Aeron. Sci., Univ. Tokyo, 1: A59-A98(Oct. 1965). (In Japanese).

Ishimura describes problems in getting high-temperature, low-density plasmas by projecting highly ionized hydrogen with a plasma gun into a cusp-magnetic field and gives general explanations referring to the data taken in his laboratory. Nakai experimentally produced ionized shock waves by using several kinds of shock tubes. Measurements of electron density in a plasma with a Mach-Zehnder interferometer and other interesting methods of measurement were introduced. Yamanaka's lecture is concerned with the study of interactions between lasers and the media and its applications, such as the mechanism of producing a

plasma by concentrating a laser beam into a very small spot and a new technique of plasma diagnostics using a laser as a light source for Mach-Zehnder interferometer. By building a model composed of many particles and tracing their behavior in an electronic computer, Hasegawa analyzed the nonlinear character of plasma in a magnetic field. Morioka shows the experiment about subsonic ionized gas flow produced by heating argon with a radiofrequency generator. He gives the general method for observing a MHD shock wave by making a supersonic ionized flow, and heating the gas with a d-c arc generator of 200 kw. He summarizes the basic equations for theoretically treating argon flows of a few ten thousands of degrees. The importance of considering a collision term is specially indicated. Niu discusses some highlights in the theory of fully ionized plasma at the present state. (auth)

24531 SELF-DIAGNOSING ELECTRODELESS PLASMA GENERATOR. Hollister, Donald D. (Philco Corp., Newport Beach, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation, AP-13: 134-40(Jan. 1965).

An apparatus is described which generates a continuously flowing plasma and simultaneously gives a measure of its conductivity. The plasma is not in thermodynamic equilibrium. Although highly conductive, it is relatively cool, thereby obviating the need for high temperature materials and techniques. The theoretical foundation for the conductivity measurement is outlined, and the calibration of the apparatus is described. A method of scaling the device to higher power levels is discussed. (auth)

24532 PULSE DISPERSION IN A GYROTROPIC PLASMA. Schmitt, H. J. (Sperry Rand Research Center, Sudbury, Mass.). Contract AF 19(628)-4183. IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation, AP-13: 934-42(Nov. 1965).

The dispersion of nanosecond electromagnetic pulses in a longitudinally magnetized plasma confined in a coaxial transmission line is observed experimentally. The transient response exhibits weakly damped oscillations characteristic of the natural frequencies of a bounded gyrotropic plasma. Measurements of the pulse dispersion caused by reflection from the plasma interface and transmission through the plasma are compared with theoretical results obtained on the basis of a dielectric model of the plasma, in which ion motion and random motions of the electrons are neglected. (auth)

24533 EFFECT OF DIELECTRIC WALLS ON PLASMA POWER COEFFICIENTS. Shockley, T. D. Jr.; Palmer, J. D.; Howe, M. L. (Univ. of Oklahoma, Norman). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation, AP-13: 976-8(Nov. 1965).

The results of Bachynski and Graf on the transmission characteristics of a semi-infinite homogeneous plasma slab bounded by lossless dielectric walls for a uniform plane wave probing at normal incidence indicates that the walls, in general, produced an impedance mismatch between the first interface encountered by the probing wave and free space. This condition, which affects the amplitude of the transmitted signal strength, is discussed. (B.G.D.)

24534 PLASMA PROBES AND THE LANGMUIR PARADOX. Hirsch, E. H. (Weapons Research Establishment, Salisbury, Australia). Int. J. Electron. (1), 19: 537-48 (Dec. 1965).

Experiments show that in a low pressure plasma the apparent electron temperature inferred from Langmuir probe measurements is not a direct index of the mean electron energy within the plasma. Electrons undergo energy transfer through radio-frequency interactions in the probe sheath and in the sheaths on the plasma boundary. Consequently the apparent electron temperature depends on the resonant properties of the sheaths and on the geometry of the probe. By altering the resonant properties of a sheath it is possible to change the apparent electron temperature without affecting the electron energy distribution within the plasma itself. (auth)

24535 BOUNDARY CONDITIONS AT A PLASMA JUNCTION WITH DRIFT CURRENT. Emeleus, K. G.; Reynolds, R. M.; Montgomery, W. B. (Queen's Univ., Belfast). Int. J. Electron. (1), 19: 555-6(Dec. 1965).

Using a spherical Langmuir probe, it has been found that a boundary condition between the Faraday dark space and the head of a striated positive column in a number of discharges through neon is an approximate equality of drift and random currents. It is possible that this may be a general condition at the junction of two plasmas traversed by drift current. (auth)

24536 WAVE PROPAGATION ALONG A WARM NON-UNIFORM PLASMA COLUMN. Crawford, F. W.; Tataronis, J. A. (Stanford Univ., Calif.). Int. J. Electron. (1), 19: 557-70(Dec. 1965).

The dipolar resonances that occur when an axially uniform plasma column is subjected to a transverse r-f electric field have received much study, and can be predicted accurately from a hydrodynamic description of the plasma perturbation and knowledge of the transverse electron density profile. These frequencies may be interpreted as the cut-offs of series of modes propagating along the column. Such propagation is studied in infinite planar geometry for a number of basic cases. Dispersion curves, and descriptions of the plasma parameters at cut-off are given for modes with axially symmetric and axially asymmetric potential distributions in three different geometries: first for plasma filling the plates, and then for plasma separated from the plates either by one of two dielectric layers. The feasibility of observing these waves experimentally is discussed, and experimental evidence for their propagation is cited. (auth)

24537 SOLUTION OF NONLINEAR BOUNDARY-VALUE TRANSPORT PROBLEMS IN ELECTRON AND PLASMA DEVICES. Dolph, C. L.; Lomax, R. J. (Univ. of Michigan, Ann Arbor). Contract AF30(602)-2834. J. Math. Anal. Appl., 13: 391-433(Mar. 1966).

A method of solution of the nonlinear Landau-Vlasov equation which occurs in charged particle transport phenomena is described. The method is similar in concept to the spherical harmonics method of neutron transport theory, since the particle distribution function is expanded in orthogonal functions of velocity to obtain an infinite set of partial differential equations. The nonlinearity arises when the particle interactions are taken into account in the force term of the Landau-Vlasov equation. The latter is introduced into the equation iteratively and a numerical integration routine is described to integrate the set of equations resulting from a finite (nth order) truncation of the expansion. The truncated equations, which are for the first n velocity moments of the distribution function, are such that these moments satisfy the untruncated equations also, whereas higher moment equations are modified by a fictitious source term. The convergence of the finite-difference equations and the convergence of the finite-difference solution to the solution of the differential equations is proved for the linear case in which the force is assumed to be known. Computational evidence of the convergence in the nonlinear case is provided, although no mathematical proof has so far been developed. (auth)

24538 FUSION ENERGY BALANCE IN MIRROR MACHINES. Fowler, T. K. (General Atomic Div., General Dynamics Corp., San Diego, Calif.); Rankin, M. J. Nucl. Energy: Pt. C, 8: 121-8(Mar.-Apr. 1966). (GA-6704).

Motivated by the encouraging outlook for stable confinement of fusion plasmas by minimum-B magnetic mirrors, an attempt was made to recalculate Q, the ratio of total fusion energy released to the injection energy required to replinish mirror losses by collisions. Fokker-Planck equations for ion and electron energy distributions were solved numerically with special attention toward ion cooling by electrons and the effect of the ambipolar potential on the velocity loss cone. It was found that both these effects enhance mirror losses much more than was supposed previously. Consequently, for a D-T plasma the Q is a factor 4 or more smaller than previous estimates,

and Q is maximum at a higher energy, 200–300 kev. For a mirror ratio R = 3, the maximum is Q = 1.5, and, for larger R, Q scales approximately as $\log_{10}R$. A negligible benefit from ion heating by collisions with trapped α particles from fusion reactions was found. (auth)

24539 CRITICAL PRESSURE FOR EQUILIBRIUM IN A TOROIDAL SYSTEM. Greene, John M.; Johnson, John L.; Weimer, Katherine E. (Princeton Univ., N. J.). J. Nucl. Energy: Pt. C, 8: 145-55(Mar.-Apr. 1966). (MATT-389).

The outward shift of a plasma column in a toroidal system is calculated using the ideal hydromagnetic equations for a stellarator model. At a critical value of the plasma pressure this outward shift becomes infinite. This is the pressure for which the equivalent straight system is marginally stable against the type of displacement induced by the toroidal curvature. The very close relation between equilibrium and stability problems is thus illustrated. (auth)

24540 DEVELOPMENT OF A HOT-ELECTRON PLASMA BLANKET. Stirling, W. L.; Neidigh, R. V.; Alexeff, I.; Meece, V. J. (Oak Ridge National Lab., Tenn.). J. Nucl. Energy: Pt. C, 8: 157-8(Mar.-Apr. 1966). (ORNL-P-1628).

A description of a large annular steady-state stable hot-electron plasma formed by magnetically trapping electrons which originate in an intense arc gas discharge is presented. The annulus is produced coaxially with the magnetic field by azimuthal drift of trapped electrons. (B.G.D.)

24541 RESONANCE PROBE. Lepechinsky, D. (CEN Saclay, France); Messiaen, A.; Rolland, P. J. Nucl. Energy: Pt. C, 8: 165-7(Mar.-Apr. 1966).

A brief account of the CEA report on the experimental verification of the simplified theory for the resonance probe and some of its extensions is presented. Results of a quantitative comparison of experimental data obtained not only for resonant frequencies but also for antiresonance and for newly established features are discussed. Experimental results of sheath thickness are compared with those obtained from numerical results of recent theories on the ion sheath. (B.G.D.)

24542 SIMPLE MODEL FOR DESCRIBING THE OPERATION OF A RAIL-TYPE PLASMA GUN. Trotel, Jacques (Compagnie Francaise Thomson-Houston, Centre Bagneus, Tubes, France). J. Phys. (Paris), 26: 251A-5A (Dec. 1965). (In French).

The operation of a rail type plasma gun is analyzed according to simple assumptions. The resulting equations are solved by an analog computer. Results are presented as a single set of curves relating the efficiency to two factors containing all the parameters considered in the basic assumptions. Experiments on a specially built gun proved the assumptions to be valid. (auth)

24543 NEUTRAL-DENSITY PROBE. Stern, P. G. (Stevens Inst., Hoboken, N. J.). Contract AT(30-1)-2813. J. Sci. Instrum., 43: 192-4(Mar. 1966).

A probe is constructed to measure the density of the neutral atoms in a quiescent magnetoplasma. The highly-ionized bounded plasma is produced in a machine similar to the Princeton University Q machine. The probe is calibrated to measure the density of neutral particles in a cesium plasma. (auth)

24544 EXCITATION AND THERMALIZATION OF PLASMA OSCILLATIONS IN A STELLARATOR. Burchenko, P. Ya.; Vasilenko, B. T.; Volkov, E. D.; Nikolaev, R. M.; Potapenko, V. A.; Tolok, V. T. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). JETP Lett. (USSR)(Engl. Transl.), 3: 156-8(Mar. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 243-7(Mar. 15, 1966).

A study on the influence of collective processes on the behavior of a plasma in a stellarator is presented. Measurements were taken of the plasma current and the loop voltage in the vacuum chamber, the plasma density, the x radiation from the diaphragm limiting the dimensions of the plasma pinch and from the chamber walls, the microwave radiation from the plasma, and the integral amount of light. (B.G.D.)

24545 HIGH-FREQUENCY INSTABILITY OF A PLASMA IN A RADIAL ELECTRIC AND LONGITUDINAL MAGNETIC FIELD. Mikhailovskii, A. B.; Tsypin, V. S. (Kurchatov Inst. of Atomic Energy, USSR). JETP Lett. (USSR)(Engl. Transl.), 3: 158-9(Mar. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 247-50(Mar. 15, 1966).

A theoretical model is presented to interpret the ion heating in a plasma, situated in a radial electric and longitudinal magnetic field, to ascertain which high-frequency instabilities ($\omega \geq \omega_{Bi}$) are possible. (B.G.D.)

24546 INFLUENCE OF MAGNETIC-FIELD CONFIGURATION ON THE HEATING AND CONTAINMENT OF A PLASMA IN A MIRROR TRAP (PROBKOTRON). Blinov, P. I.; Zakatov, L. P.; Plakhov, A. G.; Chikin, R. V.; Shapkin, V. V. (Kurchatov Atomic Energy Inst., USSR). JETP Lett. (USSR)(Engl. Transl.), 3: 163-5(Mar. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 255-8(Mar. 15, 1966).

An experiment is discussed in which a plasma is heated by an electron beam in a mirror trap with a magnetic field introduced along the trap axis. The experiment was carried out in two configurations, one with local mirrors, and the other with extended mirrors. The effect on the heating and decay of the plasma is presented. (B.G.D.)

24547 RAMAN SCATTERING OF MICROWAVES BY PLASMA OSCILLATIONS. Perepelkin, N. F. (Inst. of Physics and Tech., State Atomic Energy Commission, Sukhumi, USSR). JETP Lett. (USSR)(Engl. Transl.), 3: 165-7(Mar. 15, 1966).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redakt., 3: 258-61(Mar. 15, 1966).

Results are presented on the nonlinear interaction of microwaves with a plasma, in which Raman scattering was observed of a 4 mm wave incident from the outside by the natural oscillations of a plasma with emission of a Raman spectrum (of frequencies $\omega + \omega_{pe}$) in the 2 mm band. The scattering of the incident wave was observed from a local region in the plasma, since the wavelength and the final dimensions of the converging beam of incident electromagnetic radiation were smaller than the plasma diameter. (B.G.D.)

24548 THE STABILITY OF THREE-COMPONENTS (ELECTRON, ION, AND BEAM) PLASMA SYSTEM. Onuma, Toshiro; Hatta, Yoshisuke (Tohoku Univ., Japan). Kakuyugo-Kenkyu, 15: 637-60(Dec. 1965). (In Japanese).

The stability of three-component plasma (electron, ion, and beam) is investigated, mainly by means of a graphical solution of the dispersion equation. Three types of growing plasma waves are manifested in the kinetic theory approach. The first type is the electron wave due to the coupling of an electron beam with the electron. The second type is the electron-ion wave (hybrid acoustic mode) due to the coupling of the electron beam with the ion or an ion beam with the electron. The third is the ion wave due to the coupling of the ion beam with the ion. The region of instability as a function of wave number and beam velocity is determined and the dependence of the region on beam temperature, beam density, and ion mass is shown. The shielding effect and the Landau damping effect of the electron appear in the region of the electron-ion wave in the case of the electron beam and in the region of the ion wave in the case of the ion beam. For the ion beam, maximum-growth rate is given as a function of beam velocity, and the dependence of the rate on the temperature of the electron is shown. The structure of the unstable region is also indicated by the lines of constant growth rate. (auth)

24549 SOME STABILIZED MAGNETIC MIRROR FIELDS. Ikuta, K. (Nagoya Univ., Japan); Yamada, J. Kakuyugo-Kenkyu, 16: 1-7(Jan. 1966). (In Japanese).

Two examples of magnetohydrodynamically stabilized mirror fields are exhibited. These have no lines of force that cross the wall of a vessel. One is min $\bar{B}$ type and another is a combination of min $\bar{B}$ and min B. (auth)

24550 THE PLASMA WAVES PROPAGATING OBLIQUE TO THE EXTERNAL MAGNETIC FIELD. Kaji, Ikuo (Hokkaido Univ., Japan); Kito, Masafumi. Kakuyugo-Kenkyu, 16: 40-62(Jan. 1966). (In Japanese).

The problem of waves in a plasma propagating obliquely to the uniform external magnetic field is treated. On the basis of Vlasov's and Maxwell's equations, the dispersion relation is obtained in the form of the power series of $(k_\perp/\Omega)$, where Ω is the cyclotron frequency of electrons and the component of the wave vector $k_\perp$ is perpendicular to the magnetic field. When the distribution function for electrons is anisotropic in the equilibrium state, the dispersion relation, which is approximated to the first order of $(k_\perp/\Omega)$, becomes an algebraic equation of 10th degree. The equation is solved by the digital computer machine (HITAC 5020). It is shown that the oblique propagation has hybrid regions in which longitudinal plasma waves are coupled to transverse plasma waves, while the parallel propagation does not have such a region. As the angle between the parallel and oblique propagation increases, hybrid regions grow large. (auth)

24551 DIFFRACTION OF LIGHT BY RANDOM FLUCTUATIONS OF THE REFRACTIVE INDEX OF A PLASMA. Mazzucato, E. (EURATOM-CNEN, Frascati, Italy). Nuovo Cimento (10), 42B: 257-65(Apr. 11, 1966).

First-order perturbation theory is used to study the propagation of a beam of light through an inhomogeneous plasma with random density fluctuations both in space and time. The frequency spectrum of the scattered energy is calculated. (auth)

24552 ELECTROMAGNETIC WAVE PROPAGATION IN A WEAKLY IONIZED PLASMA. I. Caldirola, P.; De Barbieri, O.; Maroli, C. (Univ., Milan). Nuovo Cimento (10), 42B: 266-89(Apr. 11, 1966).

Starting from the Boltzmann equation for the electron distribution function and using the multiple-time-scale method, recently introduced by Frieman and Sandri, it is possible to obtain a set of equations that describes the interaction processes between an electromagnetic field and a weakly ionized magneto-plasma. Using the above mentioned technique the expressions of the electron distribution function and of the complex dielectric permittivity tensor are explicitly calculated. (auth)

24553 MACROPARTICLE ACCELERATORS AND THERMONUCLEAR FUSION. Maisonnier, C. (EURATOM-CNEN, Frascati, Italy). Nuovo Cimento (10), 42B: 332-40(Apr. 11, 1966).

Accelerating macroparticles to velocities in the range of 10^6 to 10^8 cm/s would lead to a large number of applications such as the simulation of meteors, the production of very dense plasmas and possibly the release of controlled thermonuclear energy. A review of the known methods of acceleration is presented as well as a study of their limitations, both with respect to velocity and size of the particles, and comparison is made with the trigger-criterion for very small thermonuclear explosions; none of those methods seems promising. A new method of acceleration is proposed. (auth)

24554 MODES OF THE KADOMTSEV PLASMA INSTABILITY. Huchital, D. A.; Holt, E. H. (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Rev. Lett., 16: 677-80(Apr. 18, 1966).

The characteristics of the helical instability in a helium positive column are studied by means of multiple-probe arrangements. An attempt was made to identify and distinguish between m = 0, m = 1, and m = 2 modes and to establish the relations between these modes and the oscillations in the discharge current. Understanding of these phenomena is provided by a modification of the Kadomtsev theory and an extension of the equations which describe the diffusion of the plasma. (B.G.D.)

24555 RESONANT EXCITATION OF PLASMA OSCILLATIONS BY TRANSVERSE ELECTROMAGNETIC WAVES. Stern, R. A.; Tzoar, N. (Bell Telephone Labs., Whippany, N. J.). Phys. Rev. Lett., 16: 785-7(May 2, 1966).

An experiment is described on the excitation of longitudinal electron-plasma oscillations by means of the nonlinear resonance of two transverse electromagnetic waves whose frequencies differ approximately by the electron-plasma frequency. The excitation described is the basic mechanism underlying phenomena such as stimulated light-light and Raman scattering in plasmas. This process is fundamentally different from previously reported nonlinear microwave mixing experiments. (B.G.D.)

24556 A THEORY OF RESONANCE RECTIFICATION, THE RESPONSE OF A SPHERICAL PLASMA PROBE TO ALTERNATING POTENTIALS. Buckley, R. (Science Research Council, Slough, Eng.). Proc. Roy. Soc. (London), Ser. A, 290: 186-219(Feb. 22, 1966).

It is shown theoretically how a conducting spherical probe behaves when it is immersed in a plasma, and has an alternating potential applied to it. The impedance of the probe and the rectified current which flows to it are derived as functions of the frequency of the applied potential. "Resonance" phenomena are shown to occur at a frequency somewhat less than the plasma frequency. The Boltzmann–Vlasov equation, together with Maxwell's equations, are used to derive an integral equation governing the alternating electric field in the plasma. The steady potential in the sheath used in the time-dependent Boltzmann equation is taken from the work of Bernstein & Rabinowitz. The alternating electric field is calculated on a computer, and from it, the impedance of the probe system is found as a function of frequency. The rectified electron current is obtained by a consideration of electron trajectory perturbations produced by the alternating electric field. This procedure is shown to be equivalent to an approximate solution of the non-linear Boltzmann equation. Collisions between electrons and heavy neutral particles are included through a simple relaxation term in the Boltzmann equation. External magnetic fields and uniform drifting of plasma past the probe are not considered. (auth)

24557 ON THE POINT OF EMERGENCE OF A CONICAL MICROWAVE BEAM ENTERING A PARTICULAR NONUNIFORM PLASMA COLUMN. Cullen, A. L. (Univ. of Sheffield, Eng.). Radio Sci., 1: 295-302(Mar. 1966).

A circularly symmetrical conical wave, in which E_ϕ is the only component of the electric vector, is incident upon a circularly symmetrical plasma column of radius a in which the electron density is proportional to $(a^2/r^2) - 1$ for a radial distance $r \leq a$, and is zero for $r > a$. The change in phase on reflection is determined as a function of the angle of incidence. A circularly symmetrical beam of radiation can be synthesized as an angular spectrum of conical waves, and the corresponding reflected beam is easily obtained in integral form. The position of maximum intensity in the reflected beam is found by making use of the principle of stationary phase. The results obtained are compared with ray theory and with a previous calculation for a linear gradient of electron density in a planar geometry. (auth)

24558 WAVE PROPAGATION IN DRIFTING ISOTROPIC WARM PLASMA. Unz, H. (Univ. of Kansas, Lawrence). Radio Sci., 1: 325-38(Mar. 1966).

The electro-magneto-plasma-gas-dynamics (EMPGD) equations are given for the warm, compressible electron gas, with no magnetostatic field, drifting with a constant velocity, by taking into account the fluid dynamics variables of the electron gas and using small-signal theory. Assuming harmonic time variation, an algebraic equation is found for the refractive index of the plasma characteristic waves. Particular cases are discussed and compared with previous results. (auth)

24559 REVIEWS OF PLASMA PHYSICS. VOLUME 4. Leontovich, M. A. (ed.). Rev. Plasma Phys. (USSR) (Engl. Transl.), 4: 1-241(1966).

Three papers on general problems in collisionless plasmas are presented. A separate abstract is prepared for each paper. (B.G.D.)

For abstracts of individual papers see: 24560–24562.

24560 HYDRODYNAMIC DESCRIPTION OF A COLLISIONLESS PLASMA. Volkov, T. F. Rev. Plasma Phys. (USSR)(Engl. Transl.), 4: 1-21(1966).

The rigorous description of a plasma requires the use of the kinetic equations for both the electrons and the ions. However, for a number of cases of a collisionless plasma the kinetic equations can be replaced by the simpler hydrodynamic equations. The hydrodynamic description of a collisionless plasma is presented with respect to thermal motion of particles, behavior in a strong magnetic field, macroscopic particle velocity, motion at frequencies below the ion Larmor frequency, magnetohydrodynamic equations for a system with anisotropic pressure and ideal conductivity, and problems of small oscillations of a nonisothermal plasma. (B.G.D.)

24561 COOPERATIVE PHENOMENA AND SHOCK WAVES IN COLLISIONLESS PLASMAS. Sagdeev, R. Z. Rev. Plasma Phys. (USSR)(Engl. Transl.), 4: 23-91(1966).

An integrated description of the basic concepts and results of the theory of cooperative phenomena in collisionless plasmas are presented. The physical significance of various approximate models are analyzed to obtain a qualitative description of these phenomena. (B.G.D.)

24562 COULOMB COLLISIONS IN A FULLY IONIZED PLASMA. Sivukhin, D. V. Rev. Plasma Phys. (USSR) (Engl. Transl.), 4: 93-241(1966).

A discussion is presented on the binary-collision approximation method, in which the many-body interactions between plasma particles, due to the long range nature of the Coulomb force, is reduced to an isolated and instantaneous interaction between a pair of particles. (B.G.D.)

24563 ON THE APPEARANCE CONDITION OF EDDIES IN IDEAL PLASMA. Deutsch, R. V. Rev. Roum. Phys., 10: 863-9(1965). (In Russian).

The condition for the appearance of turbulence in an ideal plasma is studied. It is shown that the condition for fulfilling Thomson's theorem is the same as the condition for annihilation of the density of moments of couples at each point of the plasma. In the same way the condition for the appearance of turbulence is analyzed as a function of the geometric structure of the magnetic field. It is shown that the variation of the radius of curvature of the lines of force is a necessary condition for the appearance of turbulence in an incompressible plasma. In the same way the particular case where $|\vec{B}|$ = const. is studied. (tr-auth)

24564 EFFECT OF REDISTRIBUTION OF ELECTRONS IN A PLASMA WAVE GUIDE IN A STRONG ELECTROMAGNETIC FIELD. Fedorchenko, A. M. (Kiev State Univ.). Ukr. Fiz. Zh., 11: 152-8(Feb. 1966). (In Ukrainian).

The method of quasilinear approximation is used to find in the second approximation static fields in plasma waveguides. Electron distribution in the plasma waveguide is calculated by means of Poisson's equation. Electrons escape from the boundary layer and are redistributed in space in accordance with formulas for a travelling wave and for a standing wave. The redistribution effect is stronger when the wave is slower. Thus, with the aid of strong electromagnetic waves the electron concentration in definite spots can be greatly increased owing to redistribution. (auth)

24565 CONVERGING CYLINDER SHOCK WAVES IN THE z PINCH WITH AND WITHOUT B_z FIELD. Boetticher, W. (Univ., Kiel). Z. Naturforsch., 20a: 1262-8(Oct. 1965). (In German).

The z pinch discharge was investigated in H_2, He, Ar, and Xe at initial densities from 2.3 to 37×10^{-7} g/cm^3. All luminescent phenomena observed can be explained by the model of a convergent cylindrical collision wave propelled out from a magnetic bottle. The capture of a superposed B_z field can be described by the collision wave model. (tr-auth)

24566 EXCHANGE CORRECTIONS TO THE LONGITUDINAL POLARIZABILITY OF A DEGENERATE ELECTRON GAS. Sips, V. (Institut Rudjer Boskovic, Zagreb). Z. Phys., 191: 461-8(1966).

An extension of the random phase approximation for the longitudinal-wave vector and frequency-dependent dielectric constant of an electron-ion system is made for electron exchange terms. From a linearization of the equation of motion an integral equation is obtained which is solved under the assumptions that the electron energy is a quadratic function of the wave number, momentum transfers are small, and the external frequency is very high or very low in comparison with the single particle excitation frequency on the Fermi sphere. The results are applied to calculations of the dielectric constant, low-frequency electric conductivity, electron-phonon matrix element, plasmon and phonon energies, phonon damping rate, and the amplitude attenuation coefficient of an acoustic wave. (J.F.P.)

24567 USING A PHOTOELECTRICALLY RECORDING FABRY-PEROT INTERFEROMETER TO MEASURE THE VELOCITIES OF PARTICLES IN A ROTATING PLASMA. Odintsova, G. A.; Vaulin, E. P. Zh. Prikl. Spektrosk., 3: No. 2, 105-8(1965). (In Russian).

The rotational velocities of atoms and ions were determined from the Doppler shift in spectral lines. A plasma accelerator of the acyclic type was used, operating in steady-state conditions. A high-current gas discharge (about 300 amps) was produced in argon at a pressure of 1 mm Hg between the cathode and the anode, which were made in the form of coaxial cylinders. The whole system was located in a homogeneous 800 oersted magnetic field parallel to the accelerator axis. The plasma in the anode (the outside electrode) was observed through slits. A Fabry-Perot interferometer-spectrograph combination was used for the observations. The interference pattern was recorded both photographically and photoelectrically. One of the photoelectric recordings for Ar I lines at 4158.6 Å is shown. The Doppler shift due to plasma rotation was measured by recording the lines alternately from different sections of the accelerator located symmetrically on both sides of the cathode. Two systems of superimposed lines are shown. The peaks marked "+" were recorded on one side of the cathode, while those marked "–" were recorded on the other side at an equal distance. The shift $\Delta\nu$ in one system of lines with respect to the other is related to the linear velocity of rotation in a given annular layer of the plasma by the expression $\Delta\nu = \nu_0(2v/c)$, where ν_0 is the frequency of the spectral line and c is the velocity of light. The average error in measurements was +0.01 cm^{-1}, which corresponds to a particle velocity of approximately 100 m/sec. A comparison between the photoelectric and photographic methods in measurements of the distribution of velocities of argon ions is also shown. Since line shape does not figure in the photographic method of measurement, the photoelectric method is preferable, particularly in cases where the lines are asymmetric. (ATD)

24568 APPLICATION OF THE QUADRATIC STARK EFFECT IN THE DETERMINATION OF CONCENTRATION OF CHARGED PARTICLES IN PLASMA BY THE SPECTRAL LINE BROADENING OF LITHIUM AND SODIUM. Grechikhin, L. I.; El'yashevich, M. A. Zh. Prikl. Spektrosk., 3: No. 3, 201-8(1965). (In Russian).

Stark constants for the quadratic Stark effect for the sharp, principal, and diffuse lines of lithium and of sodium were calculated. The calculation was based on the well known second order perturbation theory expression for energy level displacement of one-electron systems subject to an electric field. The results of calculation are given in tabular form. The effect of electron and ion impacts on the spectra line shape was determined by the use of the nonstationary electron-impact theory and the Holtsmark theory respectively. It was found that the overall half-line width was almost equal to the sum of the

half-line width due to electronic and ionic effects respectively. It is concluded that the quadratic Stark effect becomes noticeable for different lines at different charged particle concentrations, that a particular line may disappear completely at sufficiently high charged particle concentration, and that the diffuse series lines and the higher members of the sharp series are particularly sensitive to charged particles concentrations. The concentration of charged particles in a d-c arc was calculated and compared with data reported by L. I. Grechikhin. The calculated values are in good agreement with experimental data. (ATD)

24569 USE OF THE FABRY-PEROT INTERFEROMETER IN THE MICROWAVE SPECTRAL REGION AND FOR PLASMA DIAGNOSTICS. Balakhanov, V. Ya.; Striganov, A. R. Zh. Prikl. Spektrosk., 3: No. 4, 311-19(1965). (In Russian).

In view of the increased need for the application of optical methods in the millimeter spectral range, investigations of the possible uses of multibeam interferometers were carried out. The general interferometer characteristics are presented, and experiments carried out with mirrors having 0.75, 0.875, 0.935, and 0.985 reflection coefficients are described. Results cover the diffraction losses, interferometer transmission, resonant type oscillations in plane interferometers, and electron-concentration determination in a hydrogen plasma. An analysis of the data shows that the only change in interferometer operation in the microwave spectral region is caused by diffraction losses on the mirror apertures which must be added to the usual reflection and absorption losses. The instrument may be used for plasma-electron concentration determination. (ATD)

24570 INJECTION OF CHARGED PARTICLES INTO A MAGNETIC MIRROR TRAP. Akshanov, B. S.; Marinin, V. G.; Strel'tsov, A. I.; Sinel'nikov, K. D. Zh. Tekh. Fiz., 35: 2232-4(Dec. 1965). (In Russian).

A continuation is made of a study in which a method was proposed for injecting charged particles into a magnetic mirror system by allowing them first to pass through a magnetic field with cusped geometry, part of which forms one of the mirrors of the trap. It is shown that a criterion for penetration by the injected particles of the second magnetic mirror in the case of equal magnetic field strength in the two mirrors becomes more stringent (particles are captured over a wider range of energy and injection radius) provided the magnetic field strength in the second mirror is greater than that in the first. The theoretical conclusion was tested experimentally by injecting electrons of different energies into an asymmetric biconical cusped field, and reasonable agreement was found. It is concluded that the proposed method of particle injection will be reasonably efficient in strong fields, provided the ratio of the field strengths is properly chosen. (ATD)

24571 APPARATURA I METODY PLAZMENNYKH ISSLEDOVANII. (Apparatus and Methods for Plasma Investigations). Rusanov, V. D. (ed.). Moscow, Atomizdat, 1965. 363p.

Methods and apparatus for uhf diagnostics of plasma are described, including the basic uhf elements of the diagnostic apparatus, the cutoff and two-frequency methods, the resonator method, apparatus for phase measurement, and plasma locators. Apparatus for measuring characteristic radiations of plasma in the radio-wave and submillimeter ranges is considered. Corpuscular diagnostics of plasma is discussed, including the study of the neutral- and charged-particle fluxes in plasma, probing plasmas using particle beams, and study of the gas pressure and composition. (M.J.T.)

24572 AN INTRODUCTION TO DISCHARGE AND PLASMA PHYSICS. Haydon, S. C. (ed.). Armidale, New South Wales, Australia, University of New England, 1964. 525p.

Thirty-five lectures intended to outline systematically the fundamental properties of ionized gases and to provide the basic physics required for discussion of engineering problems involving discharge and plasma phenomena are presented. Discussions are included of fundamental gas and surface processes; motions of electrons and ions in gases; gas breakdown, including the Townsend theory, the dynamical approach, effects of extreme conditions, electrode-surface conditions, and magnetic and a-c fields, and breakdown in solids and liquids; properties, electric-field interactions, radiation, and magnetic-field effects of plasma; structure and applications of glow discharges; arc discharges, thermal-plasma theory, arc measurements, types of arcs, discharges at electric contacts, the arc cathode, and extinguishing an arc; the nature of a spark and its dependence on the external circuit; properties of shock waves and plasma shock phenomena; high-temperature plasmas, plasma measurements, oscillations and waves in plasma, and plasma applications; plasma heating and confinement and theory and devices of controlled-thermonuclear-power investigations. (M.J.T.)

24573 EQUIPMENT FOR GENERATION OF A PLASMA JET. Schmidt, Paul. German Patent 1,212,228. Mar. 10, 1966. Filed Feb. 22, 1963.

Converging, spherical pressure shock waves are generated in a bounded space filled with a gaseous medium, the space being provided with a nozzle located in the vicinity of the center of convergence through which the plasma is expelled and which at the same time serves for feeding the gaseous medium to be ionized. The feeding takes place between two successive shock waves. (Gmelin Inst.)

24574 PRELIMINARY IONIZING DEVICE. Seki, Yoshinaga (to Mitsubishi Electric Mfg. Co., Ltd.). Japanese Patent 1964-14239. July 7, 1965. Filed Apr. 10, 1963.

A preliminary ionizing device for use in a plasma generator is proposed. To a circular plasma container made of an insulating material are attached two small tubes also made of an insulating material. Wire electrodes are installed arcund the tubes, and the two electrodes are connected to each other through a high-frequency power source. The gas in the two tubes is ionized by the high-frequency electric field, and the charged particles thus produced diffuse into the plasma container. A high-frequency electric field applied to the gas in the plasma container then ionizes virtually all the gas. (TCO)

Shielding

Refer also to abstracts 23239, 23240, 23417, 23820, 24578, and 24801.

24575 (LNF-66/7) PASSAGGIO DI NEUTRONI DI ENERGIA $E_0 \leq 30$ Mev IN CEMENTO ORDINARIO E NEI SUOI COMPONENTI. (Passage of Neutrons with Energy $\leq$ 30 Mev in Ordinary Cement and in its Components. Note No. 307). Locci, M. A.; Picchi, P.; Verri, G. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Feb. 16, 1966. 24p. Dep. mn.

The absorption of neutrons with initial energy $E_0 \leq 30$ Mev in ordinary cement (a mixture of the following elements: H, C, O, Na, Mg, Al, Si, K, Ca, and Fe) was studied. Each of the individual components was considered as an absorber. The calculation was programmed in FORTRAN IV and the physical data and the calculation method used are reported. The results are graphed. (J.S.R.)

24576 (ORNL-TM-951) NUMERICAL SOLUTIONS OF THE ONE-DIMENSIONAL NUCLEON-MESON CASCADE EQUATIONS. Alsmiller, R. G. Jr.; Murphy, J. E.; Barish, J. (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 10p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

In shielding calculations for high-energy accelerators it is necessary to solve the nucleon-meson cascade equations numerically for very large distances. For the case of a 10-Bev proton beam and a set of quite special physical assumptions, an analytic solution was obtained and com-

pared with the numerical solution. The two solutions are shown to be in excellent agreement for thicknesses as large as 30 collision mean free paths (~2800 g/cm²). (auth)

24577 MEASUREMENT OF ABSOLUTE ENERGY LOSS OF 28-Mev ALPHA PARTICLES IN VARIOUS MATERIALS. Hosono, Kazuhiko; Ishiwari, Ryutaro, Uemura, Yoshiaki. Bull. Inst. Chem. Res., Kyoto Univ., 43: 323-9(Sept. 1965).

A method for measuring absolute energy loss and straggling of various materials for 28-Mev alpha particles is described. A broad-range magnetic spectrograph was used to measure the absolute energy values. The preliminary results for Sn, Au, and mylar are described. (auth)

24578 MAGNETIC SHIELD SIMULATOR. Levine, S. H.; Lepper, R. (Northrop Corp., Hawthorne, Calif.). Contract AF 33(615)-1220. pp 401-8 of Institute of Environmental Sciences 1965 Annual Technical Meeting. Mt. Prospect, Ill., Institute of Environmental Sciences, 1965.

A magnetic simulator that was developed for use in studies of the volume shielded by dipole magnets is described including the point dipole magnets and their calibration. The analysis of the data is also outlined. (D.C.W.)

24579 USE OF GAMMA RAYS TO MEASURE THE PROTON SHIELD EFFECTIVENESS OF THE APOLLO COMMAND MODULE. Ross, Richard C.; Krumbein, Aaron (United Nuclear Corp., White Plains, N. Y.). pp 583-91 of Institute of Environmental Sciences 1965 Annual Technical Meeting. Mt. Prospect, Ill., Institute of Environmental Sciences, 1965.

The basis of the gamma-probe technique, the application of the gamma-probe method to the Apollo Command Module, and other related gamma-probe applications are described. (G.O.Y.)

24580 DOSE LEAKAGE FACTOR FROM GAPS OF SHIELDING FACILITIES. Ishikawajima-Harima Eng. Rev., No. 27, 5-14(Jan. 1966). (In Japanese).

An experiment was performed to estimate the leakage of gamma rays through shielding gaps for some special cases. It was found that the leakage of gamma rays mainly come from penetrating gamma rays. The streaming rays of gaps are negligible compared with penetrating rays. The dose rate and the spatial distribution of the leakage gamma rays are in good agreement with those calculated by the ray analysis method. (auth)

24581 IMPROVED DOUBLE P_L METHOD APPLIED TO GAMMA TRANSPORT. Gerstl, S. A. W. (Technische Hochschule, Stuttgart). Nukleonik, 8: 101-8(Feb. 1966).

A method for calculating the penetration of gamma rays in a finite slab by solving the one-dimensional energy and angular dependent transport equation is outlined. Using half-range spherical harmonics together with the usual full-range Legendre polynomials, the boundary conditions can be formulated exactly and the strong anisotropy of the scattering kernel taken fully into account. This could not be achieved by the usual spherical harmonics technique. In addition to the well known jump discontinuity in the energy spectra at the single-scattering cutoff, a new jump effect is produced with this method, which permits an elementary physical interpretation. Numerical results are shown for a double P_1 approximation. Its accuracy in the energy spectra surpasses that of an ordinary P_3 approximation inside the slab. Furthermore this method allows the presentation of spectra of the transmitted and reflected flux, and the discussion of their dependence upon the slab thickness. (auth)

24582 CALCULATION OF THE ABSORPTION OF ENERGY OF AN ELECTRON BEAM IN MATTER. Ravin, V. S. Soviet Phys.-Solid State (Engl. Transl.), 7: 2767-8 (May 1966).

Translated from Fiz. Tverd. Tela, 7: 3430-1(Nov. 1965).

In analyses of experimental data relating to the transmission of beams of electrons with energies up to 1 Mev through matter, expressions have been derived for the mean relative energy absorbed by the medium. The expression for the ratio of the energy absorbed by a layer of matter to the energy of the incident beam is expressed in terms of tabulated functions. (B.G.D.)

24583 BACKSCATTERING FOR GAMMA RAYS FROM A POINT SOURCE NEAR A CONCRETE PLANE SURFACE. Chilton, Arthur B. Univ. Illinois Bull., Eng. Exp. Sta., Bull. No. 471, 1-62(1964).

Backscattering factors, as fractions of a direct dose rate in a vacuum, are obtained for point sources of gamma radiation, specifically cesium-137 and cobalt-60, placed near a plane interface between vacuum and concrete. The method derived is based on application of albedo principles, using the Chilton-Huddleston formulation for albedo. Previously published values of parameters for the Chilton-Huddleston formula are not used; but a new set, believed to be better, is derived. The results are considered practically applicable to air-concrete or air-ground interface situations, provided the distances of source to detector, source to interface, and detector to interface are greater than a mean free path of the source gamma radiation in the concrete or ground but substantially less than that in air. The basic methodology relates to infinite planes; however, factors for correcting these values for certain finite plane cases are derived. Limited experimental data are available and are compared with these calculations. The techniques for making the calculations for the specific radioisotopes indicated are generally applicable to any monoenergetic or mixed energy source having photons within the energy range from 0.2 Mev to several Mev. (auth)

Solid State Physics

See also CHEMISTRY — Inorganic and Physical Chemistry
METALS, CERAMICS, AND OTHER MATERIALS — Properties and Structure

Refer also to abstracts 23165, 23583, 23727, and 24199.

24584 (AD-626197) SPACE CHARGE WAVES IN A SEMICONDUCTOR PLASMA. Ingebrigtsen, Kjell A. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Nov. 11, 1964. Contract AF64(052)-484. 20p. (AFCRL-65-773). CFSTI $1.00 cy, $0.50 mn.

An expression for the impedance of a recombinating semiconductor plasma in presence of static electric and magnetic fields is developed. This general expression is specialized to detailed discussions of the cases where the static electric and magnetic fields are parallel and perpendicular respectively. Recombinations are accounted for only when the magnetic field is zero and when the direction of propagation is parallel to the static electric field, otherwise it is neglected. (auth)

24585 (AD-627302) THE MAGNETIC SCATTERING OF NEUTRONS BY NICKEL. Mook, Herbert A. Jr. (Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics). Nov. 1965. Contract SD-88. 98p. (ARPA-17). CFSTI $3.00 cy, $0.75 mn.

By using the neutron as a probe, precise information can be obtained about the spatial distribution of the magnetic moment density in a ferromagnet that is quite free of theoretical approximations. By comparison of the measured form factors with free atom form factors, and by direct calculation of the magnetic moment density from the measured neutron data, it is found that the magnetic moment distribution in iron and cobalt agreed with a model of the magnetization that imposed free atom-like distributions on a constant negative background. It was also discovered that the magnetic moment density was quite asymmetric about the nuclei in iron but almost spherical in cobalt. It

was apparent that it would be valuable to know distribution of the magnetic moment density in nickel so that it could be compared with that of iron and cobalt. The magnetic scattering amplitude for nickel was determined for the first 27 Bragg reflections. The magnetic form factor was Fourier transformed to give a three-dimensional map of the magnetic moment density directly from the measured data. The map shows clearly the asymmetry in the magnetic moment distribution. (TAB)

24586 (ANL–7108, pp 17-30) NUCLEAR RESONANCE ABSORPTION OF GAMMA RAYS. Ruby, S. L.; Selig, H. (Argonne National Lab., Ill.).

The structure of KrF_2 was investigated using the Mössbauer effect for ^{83}Kr. The results confirm previous conclusions on the bonding in molecules of rare gases. The nuclear quadrupole moment and charge radius of ^{83}Kr were also studied. (D.C.W.)

24587 (COO–972-9) ISOTOPIC EFFECT ON PHASE TRANSITION TEMPERATURE FOR LITHIUM. Snyder, Donald D. (Andrews Univ., Berrien Springs, Mich. Dept. of Physics). [1964]. Contract AT(11-1)-972. 11p. (CONF-660107–1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society Meeting, New York.

The bcc-to-hcp transition temperature was measured for several samples of isotopically enriched lithium-6 and lithium-7. (Isotopic enrichment >99%). A sonic resonance technique provided a sensitive and generally sharp indication of the phase transition. Although considerable scatter of the transition temperatures was observed, lithium-7 samples always transformed at a higher temperature than simultaneously cooled lithium-6 samples. The lithium-7 transformation occurred around 73°K and the lithium-6 around 69°K. Some of the parameters appearing to affect the transition temperature are discussed. A growth of average grain size from about 0.1 mm diameter to about 1.0 mm diameter was observed to be associated with the transition. (auth)

24588 (N–65-11397) CORRELATION OF THE ORBACH RELAXATION COEFFICIENT WITH OPTICAL LINEWIDTHS: $LaF_3:Er^{3+}$. Yen, W. M.; Scott, W. C.; Scott, P. L. (Stanford Univ., Calif.). [1964]. 17p. (NASA-CR–59553). CFSTI $1.00 cy, $0.50 mn.

The lifetime of the first excited state of trivalent erbium in lanthanum fluoride was measured, and for 0.05% erbium concentration, the inverse lifetime $W = 7.0 \pm 0.9 \times 10^{10}$ sec^{-1} was found. For this salt, this value is observed to be equal to the Orbach coefficient occurring in the spin-lattice relaxation of the ground-state doublet, recently measured by M. Schulz using electron-spin resonance techniques. The equality of the inverse lifetime and the Orbach coefficient is in agreement with existing theory. Concentration-dependent satellite structure was observed in the ground state of trivalent erbium in lanthanum fluoride, which we tentatively attribute to exchange-coupled pairs. Concentration-dependent broadening was observed in the optical transitions studied. This may be evidence of energy transfer between impurity ions. (auth)

24589 (NYO–3560-3) TRANSFORMATIONS IN AB_2 INTERMETALLIC COMPOUNDS. Progress Report, March 1, 1965–February 28, 1966. Ryba, Earle (Pennsylvania State Univ., University Park, Dept. of Metallurgy). Mar. 1, 1966. Contract AT(30-1)-3560. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Complete determinations of the crystal structures of $YbZn_2$, $HoZn_2$, and $TmZn_2$ were carried out by x-ray-diffraction techniques. From the crystallographic data, which are tabulated, the coordination number of the Ar atom in each compound was determined to be 16. An analytical procedure for the calculation of these domains was formulated, and subsequently used to obtain the domain of the Ar atom in 9 other $CeCu_2$-type compounds. It was also found that the $CeCu_2$-type structure is a structure in which the atom positions can shift, in a predictable way, to allow for changes in relative atom sizes. All $REZn_2$ (RE = rare earth) compounds were prepared and thermal analysis obtained on each. The change in melting point as the rare earth element is changed closely follows the variation in melting points among the rare earth elements themselves. Thermal arrests in these alloys are discussed. (P.C.H.)

24590 (ORNL–P–1158) STRUCTURAL PROPERTIES OF THIRTEEN TYPE-4f RARE EARTH OXIDES SINTERED AT 1600 DEG C. Curtis, C. E. (Oak Ridge National Lab., Tenn.). [1961]. Contract W-7405-eng-26. 4p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Crystal structure and petrographic data were obtained for sintered oxides of 13 type-4f rare earth elements, with the exception of promethium oxide. Petrographic data are consistent with x-ray-diffraction analyses. Anisotropy of the oxides of Sm, Eu, and Gd indicated that the monoclinic form was present. The sintered pellets were stable in air at room temperature except for those of the oxides of Pr and Nd, which disintegrated within a few hours. (P.C.H.)

24591 (TID–22848) STUDY OF INTERACTIONS BETWEEN f-SHELL TRANSITION IONS IN NON-METALLIC CRYSTALS. Final Report, February 15, 1963–September 15, 1965. (Alabama Univ., University. Dept. of Physics). Sept. 15, 1965. Contract AT(40-1)-3090. 9p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Two techniques were used to study the super exchange between f-shell ions: ESR of ion pairs located in a diamagnetic lattice; and NMR (and quadrupole) of the components in the super exchange path. The ^{35}Cl pure quadrupole frequencies were measured from the free induction decays for a number of rare earth chlorides isomorphic to $LaCl_3$. (M.O.W.)

24592 (TRG-Report–977) THE THERMAL CONDUCTIVITY OF SEMICONDUCTORS AT LOW TEMPERATURES. Probert, S. D.; Thomas, C. B. (Welsh Coll. of Advanced Technology, Cardiff). Apr. 20, 1965. 36p. Dep. BIS $1.00. HMSO 5s. 0d.

A review is presented on the thermal conductivity of semiconductors at low temperatures in the form of skeleton outlines of arguments on the theory. Lattice vibrations, formal theory of lattice thermal conductivity, phonon-phonon scattering processes, point defect scattering, electron-phonon interactions, size effects, conduction electrons, and heat conduction by electrons are discussed. (67 references). (P.C.H.)

24593 THEORY OF LASER RADIATION. Thirring, W. (Univ., Vienna). Acta Phys. Austr., Suppl. II, 70-8(1965).

An infinite laser model is described which yields a complete theoretical treatment of laser radiation since it leads to linear equations. In the model the atoms are replaced by two level (spin) systems, and the other levels are ignored. The model is restricted to ruby lasers. The atomic structure of matter is ignored, and matter is treated as a continuum. (B.G.D.)

24594 ANOMALOUS FLUORESCENT DECAY OF $LiF:UO_3$ UNDER HIGH-INTENSITY EXCITATION. Risgin, O.; Becker, A. G. (Univ. of Michigan, Ann Arbor). Appl. Opt., 5: 639-41(Apr. 1966).

Single crystal samples of $LiF:UO_3$ were tested for laser action. While no unambiguous evidence for laser oscillations was observed, the material did show anomalous fluorescent decay under the high-intensity pumping in basically two respects a short-lived (20-μsec to 30-μsec) microspike was exhibited, followed by a period of unusually slow decay. To explain the observations, a depopulation mechanism is proposed and discussed. (auth)

24595 OPTICAL PROPERTIES AND THERMAL BEHAVIOR OF NEW ABSORPTION BANDS IN OXYGEN-DOPED SILICON IRRADIATED AT LOW TEMPERATURES. Whan, R. E. (Sandia Lab., Albuquerque, N. Mex.). Appl. Phys. Lett., 8: 131-2(Mar. 15, 1966).

Several prominent new bands along with the previously reported band at 836 cm^{-1} were observed in the infrared absorption spectra of n-type quartz-crucible-grown oxygen-doped silicon irradiated by 2-Mev electrons at 80 to 150°K. Investigations of these bands revealed a striking dependence of their formation on the irradiation temperature, and the

results of annealing studies suggest that bands at 945 and 956 cm^{-1} are associated with different charge states of the same defect-impurity complex. (L.B.S.)

24596 OPTICAL ABSORPTION OF ELECTRON-IRRADIATED SEMICONDUCTING DIAMOND. Dyer, H. B.; Ferdinando, P. (Diamond Research Lab., Johannesburg). Brit. J. Appl. Phys., 17: 419-20(Mar. 1966).

The GR1 and ultraviolet optical absorption bands, which are produced in type IIa diamond by electron irradiation, do not appear in type IIb semiconducting diamond until the irradiation dose is sufficient to lead to compensation of all the impurity acceptor centers in any region of the crystal. Consequently, the GR1 and ultraviolet bands are considered to be associated with irradiation-induced donor centers. Evidence from annealing experiments suggests that the TH5 center, produced by heat treatment of irradiated type IIa diamond, is optically nonabsorbing when ionized. (auth)

24597 VARIATION WITH PRESSURE OF THE CURIE POINTS OF SOME FERRITES OF YTTRIUM AND RARE EARTHS WITH GARNET STRUCTURE. Bloch, Daniel; Chaisse, Francis; Pauthenet, Rene (Laboratoire d'Electrostatique et de Physique du Metal, Grenoble, France). Compt. Rend., Ser. B, 262: 404-7(Feb. 7, 1966). (In French).

The variation with pressure of the Curie point of the ferrates(III) $5Fe_2O_3 \cdot 3M_2O_3$ where M = Y, Gd, Tb, Dy, Er, and Yb was studied at pressures up to 6000 bar; $d\theta_f/dp$ has approximately the same value of about 1.22×10^{-3} degrees bar^{-1}. The results confirm the variation of the superexchange interactions according to the power 10/3 of the volume. (tr-auth)

24598 ELECTRON STRUCTURE OF MOLYBDENUM–TUNGSTEN ALLOYS. Kalinovich, D. F.; Kovenskii, I. I.; Smolin, M. D. (Inst. of Problems in Material Studies, Academy of Sciences, Ukrainian SSR). Fiz. Metal. Metalloved., 20: 937-9(Dec. 1965). (In Russian).

The electron transfer was investigated in the refractory Mo–W alloy system, in order to obtain data on the relative value of the charges, z, of the ionic components. The studies were carried out with 0.5-mm diameter and 70-mm long wires consisting of molybdenum with 35 atomic percent of tungsten; a thin film of either ^{90}Mo or ^{185}W was electrodeposited at the center of the wire, distributing the radioisotope within the mass by high-temperature soaking. The partial transfer of atoms that takes place when direct current is passed through the wire is accompanied by a general material transfer indicated by the migration of the labeled atoms. The effective ion charge, z*, the value of which takes into account direct interaction with the electric field and ionic effects due to the current carrier, was determined on the basis of the Einstein correlation; the diffusion coefficients needed for the calculation were also determined experimentally. The absolute values of the effective ion charges, z^*_W and z^*_{Mo}, obtained for the range from 1500 to 1900°C, indicate that the electron transfer of the tungsten ions follows a predominantly hole-type and that of the molybdenum ions, an electron-type process. A donor-acceptor relation was found to prevail between the components. (TTT)

24599 FORMATION AND CHARACTERIZATION OF DIVALENT AMERICIUM IN CaF_2 CRYSTALS. Edelstein, N.; Easley, W.; McLaughlin, R. (Univ. of California, Berkeley). J. Chem. Phys., 44: 3130-1(Apr. 15, 1966). (UCRL-16608).

Investigations were made of the paramagnetic resonance optical absorption spectra of electrolytically and radiation reduced single crystals of CaF_2, each containing 0.1 to 0.2 wt % of ^{243}Am or ^{241}Am. The spectroscopic splitting factor and hyperfine structure constant were determined. It is concluded from various features of the spectra that initially Am^{3+} is present in the CaF_2 lattice but that due to radiation from the Am decay, free electrons are formed in the lattice and some of the Am^{3+} ions are reduced to Am^{2+}. It is also concluded that since PMR is observed only from the ground crystal-field state, Γ_6, at 4°K, the crystal-field splitting of the ground electronic state must be greater than 5 cm^{-1}. (L.B.S.)

24600 DEFECT STRUCTURE OF BORATE GLASSES IRRADIATED WITH GAMMA RAYS. Nakai, Yasuo (Tokyo Shibaura Electric Co., Ltd.). J. Chem. Soc. Jap., Ind., Chem. Sect., 68: 1538-43(Aug. 1965). (In Japanese).

Electron spin resonance spectra were observed for various γ-irradiated borate glasses such as wet and deuterated borate glasses and alkali borate glasses containing more than 25 mole % alkali oxide. The irradiated wet and deuterated borate glasses give spectra consisting of five peaks (P_s center), which arise from the hyperfine interaction with a ^{11}B nucleus. In addition to the five peaks, the observed spectra display a doublet (P_H center) with 504-gauss separation for the irradiated wet borate glasses and a triplet (P_D center) with three equally spaced lines with a 77-gauss separation for the irradiated deuterated borate glasses. The R_H center and R_D center are attributed to proton and deuteron hyperfine splittings. The mechanism of the formation of the hydrogen center and the recombination between R_s center and P_H center are discussed. (auth)

24601 APPROXIMATION SOLUTIONS OF A BOLTZMANN EQUATION FOR PRIMARY ATOMS AND DEFECTS. Dederichs, Peter-Heinz; Leibfried, Guenther; Mika, Klaus (Technische Hochschule, Aachen). Nukleonik, 8: 80-7 (Feb. 1966). (In German).

A series of approximation methods were derived and discussed for a linear Boltzmann equation which describes the distribution of the final positions of a primary atom and the distribution of the holes and interstitial atoms in its cascade. The method depends on an approximation solution of the recursion equations for the distribution moment from which the distribution itself can be built. An age approximation with various improvements was derived first and then a P_1 and P_2 approximation depending on a spherical function development. In conclusion, approximations methods for large and small distances from the origin and the polynominal approximation using the Spencer-Fano method were derived. The approximations were compared with each other on the basis of examples. (tr-auth)

24602 MOESSBAUER EFFECT IN THE $Fe_{2-x}Ge$ INTERMETALLIC COMPOUNDS. Germagnoli, E.; Lamborizio, C.; Mora, S.; Ortalli, I. (Univ., Parma, Italy. CNR, Parma, Italy). Nuovo Cimento (10), 42B: 314-20 (Apr. 11, 1966).

Resonance absorption of ^{57}Fe 14.4 kev γ-rays by $Fe_{2-x}Ge$ compounds is investigated. These compounds are ferromagnetic, and contain two kinds of iron atoms, at whose nuclei induction is different. The separation of multiplets and the probability of Mössbauer effect result to be dependent on the iron content of the compound and are measured for x in the range 0.5 to 0.3. The results are discussed and compared with evidence from x-ray diffraction, polarized-neutron diffraction, and magnetic measurements. (auth)

24603 DURATION OF AFTERGLOW IN AQUEOUS SOLUTIONS OF GADOLINIUM SALTS. Terpilovskii, D. N. Opt. Spectros. (USSR) (Engl. Transl.), 19: 520-1(Dec. 1965).

Translated from Opt. Spektros., 19: 936-8(1965).

A theoretical calculation of the probability of radiationless transitions, which determines the duration of luminescence in aqueous solutions of gadolinium salts, is presented. The calculation is compared with experimental results. (B.G.D.)

24604 INFLUENCE OF THE ISOTOPIC CONSTITUTION OF THE O_2^- CENTER IN ALKALI HALIDES ON ITS REORIENTATION TIME. Sussmann, J. A. (Univ. of Sao Paulo, Brazil). Phys. Kondens. Mater., 4: 330-5(1966).

The theory of simple phonon induced reorientation of an O_2^--center in alkali halides is refined to include the effect of the symmetry of its wave function. It is shown that the diagonal terms of the strain matrix and the off-diagonal ones lead to different coupling mechanisms between phonons

and the impurity. For a rotation by $\pi/2$ of a homonuclear molecule, either one or the other of the coupling mechanisms becomes ineffective, depending upon the isotopic constitution of the molecule and its nuclear spin state. Expressions for the reorientation time are obtained. (auth)

24605 DIFFUSION OF PROTONS (TRITONS) IN PURE AND DOPED ICE MONOCRYSTALS. Blicks, H.; Dengel, O.; Riehl, N. (Technische Hochschule, Munich). Phys. Kondens. Mater., 4: 375-81(1966). (In German).

The diffusion of tritium in HF doped ice was studied as a function of HF concentration ranging from 10^{-5} to $5 \cdot 10^{-3}$ mol/l. The magnitude of the coefficient of diffusion as well as the activation energy of diffusion were found to be independent of HF concentration within this range. At a temperature of –10°C an anisotropy in the diffusion coefficient D was observed in undoped monocrystalline ice samples. In the direction perpendicular to the c-axis, D exceeded by 10% the value found in the parallel direction. An interpretation of these observations is based on a mechanism involving only vacancies. (auth)

24606 ANTIFERROMAGNETIC TRANSFORMATION OF Dy_2O_3, Er_2O_3, AND Yb_2O_3 IN THE TEMPERATURE REGION FROM 1.1 TO 4.2 DEG K. PART I. EXPERIMENTAL RESULTS. Bonrath, H.; Hellwege, K. H.; Nicolay, K.; Weber, G. (Technische Hochschule, Darmstadt, Ger.). Phys. Kondens. Mater., 4: 382-90(1966). (In German).

A mutual inductance bridge (Hartshorn bridge) was used to measure the magnetic susceptibility of single crystals and polycrystals of Dy_2O_3, 1:1 diluted (Dy, $Y)_2O_3$, Er_2O_3 and Yb_2O_3 in the temperature region between 1.1 and 4.2°K in external fields up to 3.5 kOe. In this temperature region the yttrium diluted oxide remains paramagnetic whereas the undiluted oxides Dy_2O_3, Er_2O_3 and Yb_2O_3 become antiferromagnetic with Néel temperatures of 1.20°K, 3.40°K, and 2.3°K, respectively. At the transition temperature the oxides of dysprosium and erbium show a magnetization relaxation due to bath temperature change. Relaxation times up to several minutes were observed. (auth)

24607 COLLECTIVE MAGNETISM OF Ho_2O_3 IN THE TEMPERATURE REGION FROM 1.1 TO 4.2 DEG K. PART I. EXPERIMENTAL RESULTS. Bonrath, H.; Hellwege, K. H.; Huefner, S.; Schinkmann, M.; Schuchert, H.; Weber, G. (Technische Hochschule, Darmstadt, Ger.). Phys. Kondens. Mater., 4: 391-6(1966). (In German).

A mutual inductance bridge (Hartshorn bridge) was used to measure the magnetic susceptibility of single crystals and powder samples of Ho_2O_3 in the temperature range between 1.1 and 4.2°K and in external field up to 3.5 kOe. At approximately 1.2°K Ho_2O_3 undergoes a magnetic transition. A magnetization relaxation and hysteresis effects are found near the transition temperature. (auth)

24608 MAGNETIZATION-DENSITY-WAVE INSTABILITY OF A QUANTUM PLASMA IN THE RANDOM-PHASE APPROXIMATION. Quinn, John J. (Brown Univ., Providence). Phys. Rev. Lett., 16: 731-4(Apr. 25, 1966).

The effect of magnetic interactions among the conduction electrons in metals on the de Haas-van Alphen oscillations of the magnetic susceptibility is considered in the framework of the random phase approximation. The system is shown to exhibit an instability by spontaneously supporting a spatially nonuniform magnetization. (B.G.D.)

24609 INELASTIC SCATTERING OF NEUTRONS BY SPIN WAVES IN TERBIUM. Moeller, H. Bjerrum (Research Establishment Risoe, Roskilde). Phys. Rev. Lett., 16: 737-43(Apr. 25, 1966).

An experiment is described of the spin-wave dispersion relations for magnons propagating in symmetry directions in ferromagnetic Tb. (B.G.D.)

24610 LOCAL-MODE RESONANCE—AN OPTICAL ANALOG OF MOESSBAUER EFFECT. Mitra, S. S.; Singh, R. S. (Illinois Inst. of Tech., Chicago). Phys. Rev. Lett., 16: 694-6(Apr. 18, 1966).

The theory of Mössbauer effect is applied to the resonance absorption of light by impurity-induced local modes. The resonance treated as modulation of the local mode by the host lattice phonons predicts the temperature dependence of peak position, half-width, and intensity of the absorption. (B.G.D.)

24611 DIRECT OBSERVATION OF CHANNELING IN bcc IRON FILMS. Andreen, C. J.; Wassermann, E. F.; Hines, R. L. (Northwestern Univ., Evanston, Ill.). Phys. Rev. Lett., 16: 782-4(May 2, 1966).

The direct observations of channeling in bcc iron films are reported and compared with results obtained on fcc gold films. It is shown that planar channeling plays an important role. Transmitted currents of 15-kev D^+ ions in the beam direction in an α-iron film is shown as a function of azimuthal angle and film orientation. (B.G.D.)

24612 EFFECTS OF FAST NEUTRON IRRADIATION AND OF IMPURITIES ON THE X-RAY INTENSITIES DIFFRACTED BY GERMANIUM AND SILICON CRYSTALS. Colella, R.; Merlini, A. (EURATOM, C.C.R., Ispra, Italy). Phys. Status Solidi, 14: 81-90(1966).

An investigation is made of the effects of fast neutron irradiation and of impurities on the x-ray diffraction intensities of Ge and Si crystals having low dislocation densities. Monochromatic CuKα and MoKα radiations are used in both the transmission and reflection geometrics. Appreciable increases of the integrated intensities are found for Si crystals irradiated with a dose of 3×10^{20} nvt. These increases are greatest if transmission geometry and MoKα radiation (thin crystal case) are used. There is, however, no variation in the diffraction intensities in anomalous transmission. The irradiation is found to have no effect on the diffraction intensities in Ge crystals irradiated up to 3×10^{20} nvt. With Si crystals doped with boron up to a maximum atomic fraction of 1.3×10^{-3} the intensities increase with increasing concentration of the doping element in the transmission geometry, when MoKα radiation is used. In anomalous transmission the intensities vary greatly in different regions of the most heavily doped Si crystal. (auth)

24613 MAGNETIC PROPERTIES OF Eu_3O_4. Wang, F. F. Y. (Sperry Rand Research Center, Sudbury, Mass.). Phys. Status Solidi, 14: 189-92(1966).

A new Eu_3O_4 preparation method is described. Eu_3O_4 is produced by the solid state reaction between Eu and Eu_2O_3. Static magnetic susceptibility measurements were made by the Faraday method from 6 to 300°K. Eu_3O_4 was found to be ferrimagnetic with a Curie point of 77°K. (auth)

24614 MAGNETIC SUSCEPTIBILITIES OF GADOLINIUM ORTHOPHOSPHATE ($GdPO_4$). Wang, F. F. Y. (Sperry Rand Research Center, Sudbury, Mass.). Phys. Status Solidi, 14: 193-203(1966).

Gadolinium orthophosphate ($GdPO_4$) follows the Curie-Weiss law in the paramagnetic region. It becomes antiferromagnetic at 225°K, and exhibits weak ferromagnetism at lower temperatures. The origin of weak ferromagnetism is attributed to anisotropic exchange. A model of ferromagnetic and antiferromagnetic linkages of varied strengths fits qualitatively the magnetic properties of $GdPO_4$. (auth)

24615 OPTICAL ABSORPTION BAND GROWN IN THERMALLY BLEACHED NEUTRON-IRRADIATED LITHIUM FLUORIDE. Kamikawa, T.; Kazumata, Y.; Ozawa, K. (Japan Atomic Energy Research Inst., Tokyo). Phys. Status Solidi, 14: 223-5(1966).

An absorption band having a maximum at 630 nm is observed in neutron irradiated "pure" LiF crystals, which were thermally bleached and aged. The properties of this band are studied, and its origin is discussed. (auth)

24616 ON THE FORMATION AND ANNIHILATION OF COLOUR CENTERS IN KCl MONOCRYSTALS. Agarbiceanu, Ion; Teodorescu, George (Polytechnic Inst. Gh. Gheorghiu-Dej, Bucharest). Rev. Roum. Phys., 10: 943-4(1965).

Potassium chloride monocrystals were colored by elec-

tron irradiation, and bleaching curves were obtained for different temperatures. Since the cross section of the light beam used for transmission measurements covered only half of the colored portion of the crystal, the other half was submitted only to the bleaching effect of the heating, while the first half was effected by the light as well. The spectral difference between these two portions and bleaching curves at different temperatures are shown. Also the formation and annihilation of color centers in potassium chloride crystals by electron bombardment was examined. Photographs of the diffraction images during the coloring process are shown. (J.F.P.)

24617 INTERNAL MAGNETIC FIELDS AT IRON SITES IN "TICONAL" PERMANENT MAGNETS DETERMINED BY MOESSBAUER MEASUREMENTS. van Wieringen, J. S.; Rensen, J. G. (Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). Solid State Commun., 4: 1-2(Jan. 1966).

Mössbauer measurements on single crystals "Ticonal" G show that the iron in the alloy is present both in ferromagnetic and in paramagnetic surroundings. After a thermal treatment the fraction of the latter type of iron grows while at the same time the coercive force increases. (auth)

24618 EFFECTS OF ATOMIC ORDERING ON THE MAGNETIC STRUCTURE OF Pt_3Fe. Kren, E.; Szabo, P.; Tarnoczi, T. (Central Research Inst. for Physics, Budapest). Solid State Commun., 4: 31-2(Jan. 1966).

It is shown that the chemical ordering of Pt_3Fe is accompanied by the occurrence of only the ($\frac{1}{2}$ $\frac{1}{2}$ 0) type of neutron super-reflexions. This seems to contradict the assumption according to which the decrease of the chemical order should cause the occurrence of ($\frac{1}{2}$ 0 0) type super-reflexions. (auth)

24619 CYCLOTRON RESONANCE IN PYROLYTIC AND SINGLE CRYSTAL GRAPHITE. Williamson, S. J.; Surma, M.; Praddaude, H. C.; Patten, R. A.; Furdyna, J. K. (Massachusetts Inst. of Tech., Cambridge). Solid State Commun., 4: 37-41(Jan. 1966).

Cyclotron resonance experiments on pyrolytic and single crystal graphite yielded a sequence of resonances, which can be explained solely on the basis of resonances from majority holes near point K in the Brillouin zone. Due to the interaction between the π-bands in graphite in the presence of a magnetic field, no resonance is expected or observed from the majority electrons. (auth)

24620 EXTENDED HUECKEL THEORY CALCULATION OF ATOM MIGRATION ENERGIES IN TWO-DIMENSIONAL GRAPHITE. Moore, Emmett B. Jr.; Carlson, Charles M. (Boeing Scientific Research Labs., Seattle). Solid State Commun., 4: 47-9(Jan. 1966).

Extended Hückel theory calculations were carried out on several two-dimensional models of graphite in order to examine the usefulness of this technique in calculating atom migration energies in solids. The calculations yield an activation energy of 2.3 ev for vacancy migration and an activation energy of 25.3 ev to form a Frenkel pair 3.8 Å apart, which may be compared with the experimental values of 3.15 ± 0.55 ev for vacancy migration and 25 ev for the displacement threshold. (auth)

24621 N_1 CENTERS IN ADDITIVELY COLORED KCl CRYSTALS. Schneider, Irwin (Naval Research Lab., Washington, D. C.). Solid State Commun., 4: 91-4(Feb. 1966).

The technique for ionizing F-aggregate centers is used to study two N_1 centers, termed N_{1A} and N_{1B}, produced by certain optical and thermal treatments. Absorptions and emissions occurring in the near infrared spectral region are identified as transitions of the ionized forms of these centers. (auth)

24622 RADIATION-INDUCED CHANGES IN THE PROPERTIES OF FERROELECTRICS, DUE TO AN INTERNAL BIAS FIELD. Starodubtsev, S. V.; Peshikov, E. V. (Nuclear Physics Inst., Moscow). Soviet Phys.-Solid State (Engl. Transl.), 7: 2570-3(May 1966).

Translated from Fiz. Tverd. Tela, 7: 3175-9(Nov. 1965).

Comparison and compensation methods were used to investigate the radiation-induced changes, due to the appearance of an internal bias field, in Rochelle salt and triglycine sulfate crystals irradiated with ^{60}Co γ rays. It is shown that the effects of an internal bias field are equivalent to the action of an external bias field and may be considered as secondary effects of irradiation. The characteristics of the pulse polarization reversal in irradiated triglycine sulfate crystals are described. (auth)

24623 POLARIZATION OF NUCLEAR SPINS OF SEMICONDUCTORS BY DIRECT CURRENT. Kalashnikov, V. P. (Inst. of Metal Physics, Academy of Sciences, Sverdlovsk, USSR). Soviet Phys.-Solid State (Engl. Trans.), 7: 2574-9(May 1966).

Translated from Fiz. Tverd. Tela, 7: 3180-7(Nov. 1965).

Formulas are obtained for the polarization of nuclear spins interacting with hot electrons in strong electric and magnetic fields. Various limiting cases are considered. (auth)

24624 HALL EFFECT IN NEODYMIUM AND SAMARIUM. Volkenshtein, N. V.; Fedorov, G. V. (Inst. of Metal Physics, Academy of Sciences, Sverdlovsk, USSR). Soviet Phys.-Solid State (Engl. Transl.), 7: 2599-2602 (May 1966).

Translated from Fiz. Tverd. Tela, 7: 3213-17(Nov. 1965).

The results of measurements of the Hall effect in neodymium and samarium of about 99.9% purity in the temperature range 2.4–350°K are reported. The results are compared with the field and temperature dependences of the Hall effect of heavy rare-earth metals. (auth)

24625 FORBIDDEN FINE-STRUCTURE TRANSITIONS OF THE Gd^{3+} ION IN A CeO_2 CRYSTAL. Bir, G. L.; Vinokurov, I. V. (Semiconductor Inst., Leningrad). Soviet Phys.-Solid State (Engl. Trans.), 7: 2730-6(May 1966).

Translated from Fiz. Tverd. Tela, 7: 3392-401(Nov. 1965).

A theoretical and experimental study is made of forbidden fine-structure transitions in the EPR spectrum of the Gd^{3+} ion in CeO_2. The Gd^{3+} ion is in a cubic crystal field. First-order perturbation theory in the parameter $a/g\beta H$ (a is the constant representing the interaction with the crystal field) is used to derive expressions for the matrix element of the forbidden transition $W_{M,N}$ ($N \neq M \pm 1$) and to determine the angular dependence of the intensity of the various types of forbidden lines. The angular dependence of the intensity of the forbidden lines of the Gd^{3+} ion in CeO_2 is investigated experimentally. There is good agreement between theory and experiment. (auth)

24626 APPLICABILITY OF THE APPROXIMATION OF CONTINUOUS ENERGY LOSSES BY ELECTRONS IN THE MODERATE ENERGY RANGE. Yurkov, B. Ya. (Lebedev Inst. of Physics, Moscow). Soviet Phys.-Solid State (Engl. Transl.), 7: 2742-3(May 1966).

Translated from Fiz. Tverd. Tela, 7: 3406-8(Nov. 1965).

The approximation of continuous energy losses by electrons in the range of moderate electron energies ($E \sim$ 100 kev) is discussed. The magnitude of the contribution of fast secondary electrons to the total ionization loss is calculated. (B.G.D.)

24627 DETERMINATION OF THE ENERGY OF AN ELECTRON-HOLE PAIR AND OF THE ABSOLUTE QUANTUM YIELD IN THE X-RAY-INDUCED CONDUCTIVITY OF CdS AND CdSe SINGLE CRYSTALS. Svechnikov, S. B.; Chalaya, V. G. (Inst. for Semiconductors, Kiev). Soviet Phys.-Solid State (Engl. Transl.), 7: 2750-1(May 1966).

Translated from Fiz. Tverd. Tela, 7: 3413-15(Nov. 1965).

The value of the true quantum yield in the x ray induced conductivity and the pair separation energy when CdS and CdSe single crystals were excited with monochromatic CuKα radiation were measured. (B.G.D.)

24628 SOME FEATURES OF THE MAGNETORESISTANCE OF ALKALI SILICATE GLASSES AFTER γ IRRADIATION AND HEAT TREATMENT. Belyavskaya, L. M.; Siryak, A. I. (Tomsk State Univ., USSR). Soviet Phys.-Solid State (Engl. Transl.), 7: 2764-5(May 1966).
Translated from Fiz. Tverd. Tela, 7: 3427-8(Nov. 1965).
The results of an investigation on the nature of the transverse magnetoresistance in samples of sodium silicate glasses of various compositions in a magnetic field of 0.5 to 1.9 Wb/m² after γ irradiation are presented. (B.G.D.)

24629 PARAMAGNETIC SUSCEPTIBILITY OF $PrAlO_3$. Yudin, V. M.; Gavrilishina, A. I. (Semiconductor Inst., Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 7: 2772-3(May 1966).
Translated from Fiz. Tverd. Tela, 7: 3435-7(Nov. 1965).
The inverse variation of the paramagnetic molar-susceptibility of $PrAlO_3$ as a function of temperature is presented. The measurements were made by means of a Faraday magnetic balance on single crystals. (B.G.D.)

24630 SECOND-ORDER PHASE TRANSFORMATION OF MAGNETIC CRYSTALS AND MAGNETIC STRUCTURE OF METALS OF LANTHANUM SERIES. Shen, Jue-lian (Academia Sinica, Peking). Wu Li Hsueh Pao, 22: 94-110(Jan. 1966). (In Chinese).
The stability conditions in the Landau theory of second-order phase transformation are discussed. It is shown that the restrictions imposed by Lifshitz on the change of type of symmetry are not necessary. As a consequence, the second-order transformation at the Neél point of metals of the Lanthanum series such as dysprosium, which was thus far regarded as a problem that could not be treated on the basis of the Landau theory, is amenable to theoretical treatment. The linear relation to temperature of the pitch of the helical spin structure of dysprosium is explained. In the meantime, a new method for the analysis of spin structure is developed employing the theory of space group representation and the minimum conditions of the thermodynamic potential. The results obtained by the application of this method to the magnetic structure of metals of the Lanthanum series are in agreement with the results of neutron diffraction experiments. (auth)

24631 SOME FEATURES OF γ-QUANTUM EMISSION FROM NUCLEI IN CRYSTAL LATTICES. Zaretskii, D. F.; Lomonosov, V. V. Yadern. Fiz., 3: 263-7(1966). (In Russian).
The recoilless radiation of nuclei located in a certain lattice point is investigated. The lattice consists of nuclei identical with the emitting one. The features of the spectral and angular distribution of the γ-quantum flux for certain relations between the radiation wave length and the lattice constants is clarified. (auth)

24632 SUB-LATTICE MAGNETIZATION AND EXCHANGE FIELDS OF ERBIUM IN ERBIUM–IRON PEROVSKITES AT LOW TEMPERATURE, INVESTIGATED BY MOESSBAUER EFFECT. Wiedemann, Werner (Bayrische Akademie der Wissenschaften, Munich); Zinn, Werner. Z. Angew. Phys., 20: 327-32(Apr. 1966). (In German).
The magnetic hyperfine splitting of the 80.6-kev γ radiation of ^{166}Er in $ErFeO_3$ perovskite was measured between 1.5 and 80°K using the Mössbauer technique. From the hyperfine spectra the internal magnetic fields H_i at the ^{166}Er nucleus could be determined. H_i extrapolated to 0°K is $(5.60 \pm 0.15) \times 10^6$ Oe; H_i breaks down at $T_N = (4.5 \pm 0.5)$°K, the Néel temperature of the Er^{3+} sublattice. From the H_i the effective magnetic moments $\langle \mu_z \rangle$ of the Er^{3+} ions could be deduced $\langle \mu_z \rangle_0 = (6.55 \pm 0.20)$ at 0°K. From the temperature dependence of $\langle \mu_z \rangle$ (sublattice magnetization) the splitting of the lowest Kramers' doublet of the Er^{3+} ion was estimated to be $\Delta E = (6.40 \pm 0.40)$ cm^{-1} at 0°K. Subtracting the dipolar fields an exchange field $H_{ex} = (26 \pm 4)$ kOe could be deduced, which is thought to be responsible for the antiferromagnetic ordering of the Er^{3+} magnetic moments. (auth)

24633 MEASUREMENT OF THE ABSOLUTE INTENSITY OF THE X-RAY SMALL-ANGLE SCATTERING BY DIMINISHING THE PRIMARY BEAM WITH ABSORPTION FILTERS AFTER PREVIOUS MONOCHROMATIZATION BY TOTAL REFLECTION. Damaschun, G.; Mueller, J. (Univ., Jena, Ger.). Z. Naturforsch., 20a: 1274-9(Oct. 1965). (In German).
In x-ray small-angle analysis it is possible to calculate the mean oscillation quadrate of the electron density in the sample investigated by measurement of the ratio of the energy scattered by the sample to that of the primary beam. It was shown that the necessary oscillation of the primary beam can be attained by absorption filters when the radiation is first monochromatized by total reflection on a glass block. For detection of the radiation, all usual receivers for soft x radiation, including the G-M tube, were installed. (tr-auth)

24634 DIMINUTION OF PERTURBED BEAMS BY KRATKY SCREEN SYSTEMS FOR THE INVESTIGATION OF X-RAY SMALL-ANGLE SCATTERING. Unangst, D. (Univ., Jena, Ger.). Z. Naturforsch., 20a: 1366-7(Oct. 1965). (In German).
The reduction of perturbed radiation by the use of Dratky screen systems in x-ray small-angle studies was described. The mechanism for the reduction of the perturbed beams is discussed. (J.S.R.)

24635 THERMOLUMINESCENCE METHOD FOR STUDYING HIGH-EXCITATION STATE OF RARE EARTH IMPURITIES IN CRYSTALS. Arkhangelskaya, V. A.; Feofilov, P. P. Zh. Prikl. Spektrosk., 4: 73-5(Jan. 1966). (In Russian).
It is shown that in thermoluminescence spectra of fluorite-type crystals activated by rare-earth ions (Er^{3+}, Tm^{3+}, Pr^{3+}) and subjected to irradiation by hard radiation, groups of lines are observed corresponding to transitions from high excited states (30000–40000 cm^{-1}) which permit investigation of crystal structure of corresponding terms. (auth)

24636 INFRARED SPECTRA OF RARE-EARTH FLUORIDES IN THE CsI PRISM REGION. Kustova, C. N.; Batsanova, L. R. Zh. Prikl. Spektrosk., 4: 75-7(Jan. 1966). (In Russian).
Infrared spectra of fluorides of rare-earth metals are obtained on an IKS-21 spectrometer in the region 240–400 cm^{-1} for models pressed into the form of tablets with cesium iodide. In fluoride spectra two intense absorption bands are discovered in the indicated region with a maximum at 270–290 cm^{-1} and 360–400 cm^{-1}. In the transition from hexagonal fluorides (LaF_3, P_2F_3, NdF_3) to rhomboidal fluorides (GdF_3, TbF_3, DyF_3, HoF_3, ErF_3, YbF_3) a shift is noted of the main maximum of the last absorption band in the region of shorter waves. (auth)

24637 RELATION BETWEEN THE AMPLITUDE AND THE DECAY DURATION OF SCINTILLATION SPIKES IN ZnS–Ag. Besel', V. S.; Gavrilov, F. F. Zh. Prikl. Spektrosk., 4: 185-7(Feb. 1966). (In Russian).
A definite relation existing between the radioluminescence output function and the duration of scintillation spikes excited by α particles. An operation mechanism analogous to the action of the exciting light is assumed. (auth)

24638 CONFERENCE ON MAGNETISM AND MAGNETIC MATERIALS, SAN FRANCISCO, NOVEMBER 16–19, 1965. J. Appl. Phys., 37: 937-1489(Mar. 1, 1966). (CONF-651106).
The conference included 253 papers; 32 were in abstract form only. Separate abstracts were prepared for 35 papers. One paper previously appeared in NSA as 19: 47507. The remaining papers included such topics as magnetic metals, alloys and intermetallic compounds, garnets and other compounds, films, magnetic resonance, spin waves and microwave applications, superconductivity and transport properties, magneto-elastic phenomena, neutron scattering, antiferromagnetism and theory. Also included were permanent magnets, dilute alloys, chemistry of magnetic materials, and critical phenomena in magnetism. (J.F.P.)

For abstracts of individual papers see: 22990, 23789, 24277–24279, and 24639–24668.

24639 MAGNETIC ORDERING IN Eu_3O_4 AND $EuGd_2O_4$. Holmes, L. (Harvard Univ., Cambridge, Mass.); Schieber, M. Contract AF19(628)-3874. J. Appl. Phys., 37: 968-9 (Mar. 1, 1966).

The magnetic susceptibilities of single crystalline and polycrystalline Eu_3O_4 and of polycrystalline $EuGd_2O_4$ in the range between 2 and 300°K are reported. The compounds are antiferromagnetic with $T_N = 5.0$ and 4.5°K, respectively. Above T_N the susceptibilities follow Curie-Weiss laws, with $\theta_P = -5$ and +2°K, respectively. Eu_3O_4 is metamagnetic below T_N with $H_c = 2.4$ kOe at 2°K. Possible magnetic structures for Eu_3O_4 are discussed. (auth)

24640 STRUCTURE AND MAGNETIC PROPERTIES OF $Dy_2Mn_4O_9$. Nowik, I.; Williams, H. J.; Van Uitert, L. G.; Levinstein, H. J. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 37: 970-1(Mar. 1, 1966).

Single crystals of $Dy_2Mn_4O_9$, a new rare-earth transition metal oxide, were grown by a three-component flux method. X-ray studies indicate that the space group of this crystal is P_{bam} and the dimensions of the orthorhombic unit cell are; a = 7.24, b = 8.44, c = 5.62 Å. Magnetization measurements at 1.3 to 300°K in a magnetic field of 14.2 kOe show that an antiferromagnetic transition takes place in $Dy_2Mn_4O_9$ at about 8°K. Large magnetic anisotropy is observed, the easy direction of magnetization lying along the a axis. At 4.2°K in a field of 100 kOe the magnetization along the c axis is less than 50% of that along the a-axis. In Mössbauer studies of the 26-kev γ-transition in ^{161}Dy typical paramagnetic relaxation spectra were observed, from which the "g" tensor of the ground stark level of the Dy^{3+} ions was deduced; $g_z = 18.5 g_x \approx 0$, $g_y \approx 0$. The spin-relaxation time of the Dy ions at 5°K was estimated to be 2×10^{-9} sec. (auth)

24641 EFFECT OF ELECTRON CONCENTRATION ON MAGNETIC PROPERTIES OF EuTe-GdTe. Holtzberg, F.; McGuire, T. R.; Methfessel, S. (IBM Watson Research Center, Yorktown Heights, N. Y.). Contract AF 49(638)-1230. J. Appl. Phys., 37: 976-8(Mar. 1, 1966).

The systems EuSe–GdSe and EuS–GdS show a strong increase in the positive value of the paramagnetic Curie temperature (θ) as a function of the Gd^{3+} concentration. The pure europium chalcogenides in both systems have positive θ values. The effect of the increase of electron concentration on magnetic interactions in EuTe, which is antiferromagnetic in its pure state is discussed. It is found that θ increases from −10°K for EuTe to a maximum of +28°K for $Eu_{0.8}Gd_{0.2}Te$ and then decreases monotonically with increasing Gd content to $\theta = -90$°K for GdTe. The variation of θ is interpreted as a result of a Ruderman-Kittel-Yosida type interaction via the conduction electron donated by Gd^{3+}. In contrast to the selenide and sulfide systems, no true ferromagnetic order occurs in EuTe–GdTe at 4.2°K for any composition. As an example, the magnetization of $Eu_{0.8}Gd_{0.2}Te$ ($\theta = +28$°K) saturates at 4.2°K for magnetic fields only above 45,000 Oe, which may be due to either spin canting or a more complex magnetic structure involving ferromagnetic clusters. (auth)

24642 MAGNETIC STRUCTURE OF $EuTiO_3$. McGuire, T. R. (IBM Watson Research Center, Yorktown Heights, N. Y.); Shafer, M. W.; Joenk, R. J.; Alperin, H. A.; Pickart, S. J. Contracts AF 49(638)-1230; AF 49(638)-1379. J. Appl. Phys., 37: 981-2(Mar. 1, 1966).

Europium titanate has the cubic perovskite structure containing divalent Eu (7 μ_B) and tetravalent Ti. From magnetic measurements it is found that $EuTiO_3$ is one of the few antiferromagnetic materials with a positive θ ($T_N = 5.3$°K, $\theta = 3.8$°K). At 1.3°K the magnetic moment (σ) increases linearly with field to 10 kOe; above 14 kOe the moment saturates and $\sigma = 156$ emu/gm (6.93 μ_B) at 20 kOe. Powder neutron-diffraction work indicates that $EuTiO_3$ has the Type G magnetic structure in which a given Eu^{++} has six nearest-neighbor europium ions antiparallel and 12 next-nearest-neighbor europium ions parallel. In a perovskite structure where only the 12-coordinated ion is magnetic, i.e., Eu^{++}, the molecular field relations for a two sublattice model yield $J_1/k = -0.021$°K, where J_1 is the effective intersublattice exchange interaction, and $J_2/k = 0.040$°K, where J_2 is the effective intrasublattice exchange interaction. The signs of J_1 and J_2 are opposite to those found in the europium chalcogenide series. The chalcogenides, however, have the rocksalt structure in which the number of 90° cation-anion-cation interactions differs from the perovskite structure. (auth)

24643 MICROWAVE MAGNETOELASTIC EFFECT IN THIN FILMS OF Dy, Ho, Gd, AND Er. Maley, M. P.; Blackstead, H. A.; Donoho, P. L. (William Marsh Rice Univ., Houston, Tex.). J. Appl. Phys., 37: 1006-7(Mar. 1, 1966).

The generation of microwave acoustic pulses in thin films of four of the rare-earth metals were observed. The pulse-echo technique common to ultrasonic studies in solids was employed. Acoustic generation in Dy, Gd, Ho, and Er was observed at frequencies between 0.8 and 9.2 GHz at temperatures between 4.2 and 130°K. This effect appears in the antiferromagnetic region only at field values greater than the critical field for ferromagnetic alignment. In Dy, with the magnetic field along the film normal, the echo amplitudes exhibit a monotonic increase with magnetic field up to 20 kOe at 1.0 GHz and 4.2°K. In Gd, however, a resonant peak is seen under the same conditions, similar to that observed in nickel alloys. In Er and Ho acoustic power reaches a plateau at 14 kOe at 1.0 GHz and 4.2°K. The magnetic-field values at which appreciable acoustic generation is observed are generally much lower than would be necessary for ferromagnetic resonance at the frequencies used. (auth)

24644 IMPURITY SCATTERING OF THE CONDUCTION ELECTRONS IN DYSPROSIUM ALLOYS. Chen, C. W. (Westinghouse Research Labs., Pittsburgh). Contract AF 49(638)-1245. J. Appl. Phys., 37: 1026-7(Mar. 1, 1966).

The electric resistivities of the intra-rare earth alloys of dysprosium were determined at 4.2, 77, and 296°K for a continued study of the impurity scattering of the conduction electrons. The resistivity data reveal that substitution of La, Ce, Pr, Nd, and Sm in Dy leads to considerable increases of the residual resistivity of Dy at low temperatures, but the increases disappear at 296°K. The impurity-induced resistivities $\Delta\rho_0$ are predominantly due to the exchange scattering of the electrons via the Ruderman-Kittel-type exchange interaction between the 4*f* and conduction electrons. The exchange scattering is shown to depend only on the difference between the atomic spins of the solvent and solute ions, with the spin–orbit coupling playing an insignificant role. Since these features were also observed in the Gd alloys, they are considered to be characteristic of the impurity scattering of the electrons in all rare-earth alloys. In the Dy alloys, however, the contribution to $\Delta\rho_0$ of the electrostatic scattering is much larger than that found in the Gd alloys. Also, at 77°K, the resistivities of the Dy alloys containing such solutes as Ce, Pr, and Nd show complex behavior, due probably to the formation of an antiferromagnetic spin structure. (auth)

24645 NEUTRON-DIFFRACTION STUDIES OF MAGNETIC STRUCTURES IN Ho–Er ALLOYS. Shirane, G. (Brookhaven National Lab., Upton, N. Y.); Pickart, S. J. Contract AT(30-2)-Gen-16. J. Appl. Phys., 37: 1032-3 (Mar. 1, 1966). (BNL–9616).

Neutron-diffraction studies were made on a single crystal of $Ho_{0.5}Er_{0.5}$ as well as on two polycrystalline samples, $Ho_{0.7}Er_{0.3}$ and $Ho_{0.4}Er_{0.6}$. The magnetic structures of these alloys at 4°K are ferromagnetic cone spirals propagating along the c axis, as in both end members. The magnitude of observed magnetic moments indicates that these alloys form uniform magnetic structures with respect to the cone angle. This conclusion is in contrast to the model in which the magnetic-moment direction of each constituent atom is mainly determined by its own anisotropy with an average cone angle and spiral periodicity. The temperature dependence of magnetic intensities of the $Ho_{0.5}Er_{0.5}$ crystal was

studied in detail. The cone angle of the ferromagnetic cone structure increases with temperature and the structure transforms to a pure spiral mode at 33°K without a noticeable discontinuity in the total moment value. The spiral structure is retained up to the Néel temperature at 104°K in contrast to pure Er where an additional sinusoidally modulated phase was observed below the Néel point. (auth)

24646 SOME NEUTRON-DIFFRACTION INVESTIGATIONS AT THE NUCLEAR CENTER OF GRENOBLE. Bertaut, E. F.; Bassi, G.; Burlet, P. (and others) (CEN-G, Grenoble, France. CNRS, Grenoble, France). J. Appl. Phys., 37: 1038-9(Mar. 1, 1966).

In the orthorhombic $CrRO_3$ (R = rare earth and Y), Cr spins are ordered in a G mode between T_N 282°K for R = La, to 112°K for R = Lu. The rare-earth ordering is coupled to the Cr-spin ordering, with the exception of terbium. In the magnetoelectric compound $Fe_{1.15}Ga_{0.85}O_3$, four sites are available for cations, one of these mainly occupied by Ga. Neutron-diffraction and magnetic-susceptibility measurements give evidence of a ferrimagnetic ordering. Tetragonal FeS shows no evidence for magnetic ordering by neutron diffraction and Mössbauer effect down to 1.7°K. The CrS–MnS solid solution has NaCl type. First kind of face-centered magnetic ordering is observed. (auth)

24647 SCATTERING OF POLARIZED NEUTRONS BY SPIN WAVES IN YIG. Ferguson, G. A. Jr.; Saenz, A. W.; Podgor, S. (U. S. Naval Research Lab., Washington, D. C.). J. Appl. Phys., 37: 1050-1(Mar. 1, 1966).

The neutron diffraction technique was employed to study the inelastic scattering of polarized 1.08-Å neutrons by magnetic spin waves in yttrium iron garnet (YIG) at room temperature. Measurements were made for the case when the YIG scatterer was oriented near the position for (220) Bragg reflection. Quantitative confirmation was obtained for the theoretical predictions of the dependence of this scattering on the incident neutron polarization. Two new methods are described for determining the parameter D appearing in the expression Dk^2 for the energies of long-wavelength acoustic magnons in usual ferromagnets and ferrimagnets. These methods require only measurements of the peak intensities of the diffuse magnetic reflections. The values $D = 0.25(+0.04, -0.03)$ ev·Å^2 and $D = 0.26 \pm 0.02$ ev·Å^2 were obtained for YIG by these procedures. (auth)

24648 OBSERVATION OF THE DISPERSION RELATION FOR SPIN WAVES IN HEXAGONAL COBALT. Alperin, H. A. (U. S. Naval Ordnance Lab., Silver Spring, Md. Brookhaven National Lab., Upton, N. Y.); Steinsvoll, O.; Shirane, G.; Nathans, R. J. Appl. Phys., 37: 1052-3 (Mar. 1, 1966). (BNL–9648).

The acoustic branch of the spin-wave spectrum of hexagonal cobalt was measured for values of the magnon wave vector q up to $qc/2\pi = 0.2$ by observing the inelastic scattering of polarized neutrons by the diffraction method. The results indicate a decided departure from the dispersion law expected for a Heisenberg ferromagnet. In particular, if the energy is expressed as a sum of q^2 and q^4 terms, then the q^4 term should only contribute 3% to the energy, whereas a contribution of 35% is observed. The coefficient of the q^2 term yields an exchange stiffness parameter $D = 490 \pm 20$ Mev·Å^2. (auth)

24649 MAGNETIC PROPERTIES OF NICKEL–IRON ALLOYS BOMBARDED BY NEUTRONS IN A MAGNETIC FIELD. Nesbitt, E. A. (Bell Telephone Labs., Inc., Murray Hill, N. J.); Chin, G. Y.; Williams, A. J.; Sherwood, R. C.; Moeller, J. J. Appl. Phys., 37: 1218-19 (Mar. 1, 1966).

Single crystals of three compositions in the Fe–Ni system (30% Ni, 50% Ni, and 76% Ni) were irradiated with neutrons (0.5×10^{18} neutron/cm^2) in the presence of a magnetic field of 2000 Oe. Neutron irradiation affected the properties of all three compositions. In the 30% Ni alloy, the temperature at which the martensitic transformation starts was raised by neutron irradiation from 213 to 262°K while the temperature range for almost complete transformation was greatly broadened from a 9 to a 139° width. These effects of changing the transformation that were produced by neutron irradiation were simulated by cold rolling. The 50% Ni alloy showed a uniaxial anisotropy which is maximum when the magnetic field was directed in the [001] direction and a minimum in the [111] direction. This behavior which differs from the usual magnetic annealing effect tends to substantiate the work of Pauleve et al. The latter have shown the existence of an ordered pulse in the 50% Ni alloy. As a result of neutron irradiation, the 76% Ni alloy became highly ordered and a high value of crystal anisotropy was obtained in a relatively short period of time. This work indicates that neutron irradiation at the proper temperature is a powerful method of obtaining long-range ordering in certain alloys of the Ni–Fe system. (auth)

24650 MICROWAVE ABSORPTION IN RARE-EARTH METALS. Bagguley, D. M. S.; Liesegang, J. (Oxford Univ.). J. Appl. Phys., 37: 1220-1(Mar. 1, 1966).

Microwave absorption phenomena were investigated in single crystals of the rare-earth metals Tb, Dy, Ho, and Er, at frequencies of 9.44 and 35.3 Gc/sec over the temperature range 10 to 290°K. Microwave absorption occurs at the critical-field transitions for the antiferromagnetic phase. Additional absorption lines were observed in the ferromagnetic phases of Tb and Dy. (auth)

24651 ULTRABROAD FERROMAGNETIC RESONANCE IN DYSPROSIUM METAL. Rossol, F. C.; Jones, R. V. (Harvard Univ., Cambridge, Mass.). Contract AF 19(628)-3874. J. Appl. Phys., 37: 1227-9(Mar. 1, 1966).

An extremely broad ferromagnetic resonance was observed in single-crystal Dy metal at 37 Gc/sec. Although the large planar anisotropy results in a much higher resonance frequency, the resonance was brought down by applying a high field along a hard direction of the in-plane anisotropy. The temperature dependence of the field for resonance, in the temperature range from 78 to 103°K, was found to follow the behavior of the in-plane anisotropy. Above 87°K the zero field ordering is spiral but ferromagnetic ordering is induced by the applied field. The resonance peak cannot be seen above 103°K because the field for resonance is no longer sufficient to induce ferromagnetic ordering. The absorption was found to be extremely broad in field so that appreciable absorption occurs even where the resonant frequency is far above the experimental frequency. This feature may be interpreted on the basis of either or both of two distinct models. The first relies upon the fact that the spin-wave spectrum decreases to a minimum at a nonzero wave vector k_0 and might thereby provide a number of $k \neq 0$ modes degenerate with the experimental frequency which may be coupled to through various sample inhomogeneities. The second model considers a very large dynamic broadening of the ferromagnetic resonance such as might arise from large magnon-phonon coupling due to the extremely large magnetoelastic interaction in dysprosium. On this model, the shape and width of the absorption curve indicate a relaxation frequency on the order of the resonance frequency. (auth)

24652 ANISOTROPIC HYPERFINE INTERACTIONS IN $ZrFe_2$ AND $GdFe_2$ FROM A NUCLEAR MAGNETIC RESONANCE STUDY. Gegenwarth, R. E. (Fordham Univ., Bronx, N. Y.); Budnick, J. I.; Skalski, S.; Wernick, J. H. J. Appl. Phys., 37: 1244-5(Mar. 1, 1966).

The nuclear magnetic resonance of ^{57}Fe nuclei in the magnetic state of both $ZrFe_2$ and $GdFe_2$, using the technique of spin echoes was studied. The broad spectrum from the iron nuclei in $ZrFe_2$ at 4.2°K could be resolved into one weak and one strong line located at 28.9 ± 0.2 and 30.6 ± 0.1 Mc, respectively. The frequencies of these lines are in good agreement with the Mössbauer results in this system which show two lines, with an intensity ratio of 3 to 1, arising from nuclei in domains. The application of magnetic fields less than $4\pi/3$ M_s to the stronger Zr reso-

nance at 77°K produces a detectable frequency shift and a decrease in intensity of the spin-echo signal. In $GdFe_2$, a ferrimagnet, a similar spin-echo spectrum for the iron is observed with one weak and one strong line at 31.3 ± 0.3 Mc and 32.4 ± 0.1 Mc, respectively. The difference between this system and $ZrFe_2$ may be understood in terms of the contribution from the magnetic gadolinium sublattice. It is concluded that in these systems, the anisotropy observed by the Mössbauer technique is detectable in nuclear spin-echo spectra. (auth)

24653 HYPERFINE FIELDS AND ISOMER SHIFTS IN MAGNETICALLY ORDERED EUROPIUM COMPOUNDS. Wickman, H. H. (Bell Telephone Labs., Inc., Murray Hill, N. J.); Nowik, I.; Wernick, J. H.; Shirley, D. A.; Frankel, R. B. J. Appl. Phys., 37: 1246-7(Mar. 1, 1966).

The Mössbauer technique was employed to study hyperfine fields in several ordered divalent europium compounds at low temperatures. The intermetallics $EuCu_2$, $EuAl_2$, and $EuAl_4$ were ordered at helium temperatures and the observed fields and isomer shifts were 189(8) kOe, −0.88 cm/sec; 278(8) kOe, −0.97 cm/sec; and 290 (8) kOe, −1.14 cm/sec, respectively. Comparison of these results and previous measurements with EuO, EuS, and Eu metal indicates a possible correlation between isomer shift and internal field. With the exception of $EuCu_2$ the internal fields increase with increasing magnitude of isomer shift. Interpretation of this trend with a core-polarization model yields a value of 120 ± 20 kOe for the field per 6s valence electron. (auth)

24654 CONDUCTION ELECTRON POLARIZATION IN MIXED SCANDIUM LAVES PHASES WITH COBALT AND NICKEL. Barnes, R. G.; Beaudry, B. J.; Lecander, R. G. (Iowa State Univ., Ames). J. Appl. Phys., 37: 1248-9 (Mar. 1, 1966). (IS–1283).

The Knight shift K and linewidth δH of the ^{45}Sc NMR in the cubic Laves phase intermetallic system $Sc(Co\ Ni_{1-x})_2$, where $0 \leq x \leq 1$, were investigated at 300°K. In accord with the probable simple Pauli paramagnetism of $ScNi_2$, K = +0.39%, whereas in $ScCo_2$, K = −0.43%, indicative of a d-spin contribution to K from the $Co^0(d^9)$ ions. In $ScCo_2$, δH may be interpreted as resulting from the exchange-narrowed dipolar field of the Co ions, with J/k = 0.44°K. In the mixed compounds, δH varies linearly both with applied field H and composition x above and below x = 0.5, and the average K varies smoothly, but not linearly, between the $ScNi_2$ and $ScCo_2$ values. The field and composition dependence of δH may be interpreted in terms of a distribution of K values resulting from the random distribution of Co neighbors. Preliminary measurements of the volume susceptibility indicate that the Knight shift and susceptibility may be directly correlated. (auth)

24655 ^{27}Al KNIGHT SHIFT AND HYPERFINE INTERACTION IN $GdAl_2$. Jones, E. D. (Sandia Lab., Albuquerque, N. Mex.); Budnick, J. I. J. Appl. Phys., 37: 1250-1 (Mar. 1, 1966).

A new ^{27}Al NMR was observed in the paramagnetic state of $GdAl_2$ between 350 and 575°K. The ^{27}Al NMR linewidth δH was found to be strongly temperature-dependent. Data are presented which suggest that the previously reported ^{27}Al NMR in $GdAl_2$ is probably due to a small amount of some other Gd–Al compound. The ^{27}Al Knight shift is temperature-dependent, varying from about −6% to −3% between 350 and 575°K, respectively. The temperature-dependent part of the Knight shift obeys a Curie-Weiss law, i.e., $K(T) \propto (T-\theta)^{-1}$, with $\theta \simeq 150$°K. The temperature-independent part of the Knight shift is consistent with the value measured for the nonmagnetic isomorph $LaAl_2$. Extrapolating the Knight shift data to 300°K and combining K(300) with the room-temperature susceptibility χ(300) yields an effective ^{27}Al hyperfine field $H^{hf} \simeq -6.8$ kOe per Bohr magneton. An ^{27}Al hyperfine field in the ferromagnetic state is thus calculated to be $^{27}H \simeq -46$ kOe in good agreement with experiment. The $s-f$ exchange energy is calculated to be $\mathcal{J}_{sf} = -0.13$ ev. The ^{27}Al nuclear quadrupolar coupling constant was measured to be $(e^2qQ/h) \simeq 4.27$ Mc. (auth)

24656 FERRIMAGNETISM OF THE RARE-EARTH-COBALT INTERMETALLIC COMPOUNDS R_2Co_{17}. Strnat, K.; Hoffer, G.; Ostertag, W.; Olson, J. C. (Air Force Materials Lab., Dayton, Ohio). J. Appl. Phys., 37: 1252-3(Mar. 1, 1966).

Saturation moments, Curie temperatures, and supporting crystallographic data are reported for a series of ferrimagnetic intermetallic compounds of the stoichiometry R_2Co_{17}, where R is any of the rare-earth elements Y, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, and Lu. The saturation moment of Y_2Co_{17} is 27.2, that of Lu_2Co_{17} is 27.6 Bohr magnetons per formula unit, indicating a cobalt moment of 1.61 μ_B in this series. Substitution of Pr and Nd for R raises the saturation to 32.8 μ_B/F.U. for Pr_2Co_{17}; all other lanthanides lower it (minimum: 5.7 μ_B/F.U. for Ho_2Co_{17}). Except for Sm_2Co_{17}, the values agree well with the concept that the Co moments couple antiparallel with the rare-earth spin sublattice. For Ce and Pr, a valence >3 and electron transfer from R to Co must be assumed. The Curie temperatures lie between 795° and 940°C. The variation of T_c with the atomic number suggests that two coupling mechanisms are active: direct Co–Co exchange interaction and indirect exchange between R and Co via polarized conduction electrons. (auth)

24657 MAGNETIC STUDIES OF GADOLINIUM COMPOUNDS WITH THE CsCl STRUCTURE. Alfieri, G. T.; Banks, E.; Kanematsu, K. (Polytechnic Inst. of Brooklyn). Contracts AF 49(638)-1402; DA-31-124-ARO(D)-70. J. Appl. Phys., 37: 1254-5(Mar. 1, 1966).

The dominant interaction in rare-earth compounds with the CsCl structure is the Ruderman-Kittel-Yosida exchange due to polarization of the conduction electrons. In the rare-earth systems RA (where A = Ag, Cu, Zn, Cd, In), it was found that RAg and RCu are antiferromagnetic; RZn and RCd are ferromagnetic; RIn is antiferromagnetic. This change in magnetic properties can be attributed to the variation of conduction-electron concentration. The ternary solid solutions: $Gd(Zn_xAg_{1-x})$, $Gd(Zn_xIn_{1-x})$, $Gd(Zn_xCu_{1-x})$, and $(Gd_{1.2}Cd)_x(GdAg)_{1-x}$ [$0 \leqq x \leqq 1$] were prepared to study the effect of changes in electron concentration on the magnetic properties of these materials. The Curie temperature of GdZn and $Gd_{1.2}Cd$ are about 280°K; the Néel temperatures of GdAg, GdCu, and GdIn are reported to be 145, 41, and 28°K. The change of the paramagnetic Curie temperatures in the $Gd(Zn_xAg_{1-x})$ and $Gd(Zn_xIn_{1-x})$ systems is in qualitative agreement with the $Gd(Ag_xIn_{1-x})$ system as reported by Sekizawa et al., and is consistent with theoretical expectations, assuming that Ag, Zn, and In give one, two, and three conduction electrons. In the composition region $0.4 \leqq x \leqq 1$, both systems are ferromagnetic and the Curie temperature decreases as x decreases. At x = 0.2 the compounds are probably antiferromagnetic. The total magnetic moment also diminishes as x decreases, in a field of 4 kOe. The total moment is expected to remain constant at 7 μ_B/Gd for the ferromagnetic compounds at higher fields. The $Gd(Zn_xCu_{1-x})$ and $(Gd_{1.2}Cd)_x(GdAg)_{1-x}$ systems show the same trend. (auth)

24658 MAGNETIC BEHAVIOR OF THIN FILMS OF NICKEL AND GADOLINIUM NEAR THE CURIE POINT. Livesay, B. R.; Jordan, L. K.; Scheibner, E. J. (Georgia Inst. of Tech., Atlanta). J. Appl. Phys., 37: 1266-7 (Mar. 1, 1966).

Magnetization measurements were made on thin films of nickel and gadolinium near the Curie point using a torque technique. The films were prepared by evaporation in pressures of 10^{-7} and 10^{-8} torr. Most of the measurements were made with a torsion magnetometer and the others with an automatic torquemeter system. The relative magnetization σ near but below T_c is described by $\sigma = D(1-\tau)^f$, where $\tau = T/T_c$. The value of f is obtained by using the procedure of Callen and Callen. Plots of $\sigma^{(1-f)}/f d\sigma/d\tau$ for nickel films were flat for $f = \frac{1}{2}$ for temperatures $0.90 < \tau < 0.95$ and peaks for $f = \frac{1}{3}$ are observed at lower temperatures. Gd films gave $f = 0.6$ for temperatures $0.8 < \tau < 0.9$ and $f = \frac{1}{2}$ for $\tau > 0.9$. The $\frac{1}{2}$-power behavior is in agreement with molecular-field

theory and the Landau theory for second-order transitions. (auth)

24659 LOCALIZED IMPURITY STATES IN METALS: DILUTE SOLUTIONS OF Ni IN Be. Klein, A. P.; Heeger, A. J. (Univ. of Pennsylvania, Philadelphia). J. Appl. Phys., 37: 1346-7(Mar. 1, 1966).

Measurements of the residual resistivity as a function of solute concentration in dilute alloys of nickel in beryllium are reported. The resistivity data together with specific-heat measurements on similar dilute alloys of the same system determine the occupation number and level width of the virtual d-states on the nickel impurity. The results indicate that the number of d electrons per nickel atom is approximately 8.7, and that the virtual level width is about 0.4 ev. This relatively narrow width is to be compared with the much greater value of the Coulomb-exchange quantity; $(U + 4J) \simeq 7$ ev. The anomalously large residual resistivity for Ni in Be appears to be the result of the small number of carriers in the nearly filled band of Be. (auth)

24660 MAGNETIC STRUCTURE PROPERTIES OF Tb–Sc ALLOYS. Child, H. R.; Koehler, W. C. (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 37: 1353-4 (Mar. 1, 1966).

The results of a neutron-diffraction study of the magnetic-structure properties of the Tb–Sc alloy system are reported. Five binary alloys with Tb content from 90 at. % to 25 at. % were examined by powder techniques from 300°K down to liquid-helium temperatures to determine the magnetic ordering temperatures and the magnetic structures. The dilution by Sc causes the spiral magnetic phase of Tb to remain stable over a temperature interval larger than in the pure metal. This effect is the same general behavior as that found in the Tb–Y system previously reported. However, the Néel points of the Tb–Sc alloys fall well below those found for Tb–Y and the initial turn angles are smaller in this system. T_N falls more rapidly for Tb–Sc alloys than for Tb–Y alloys as a function of the effective spin variable $x = c(g-1)^2J(J+1)$, where c is the atomic percent of Tb, and reaches 0°K at x about 2.5. The 25% Tb alloy shows no visible magnetic order down to 1.3°K in contrast to the Tb–Y system where magnetic order was observed with as little as 5 at. % Tb. The universal curve of T_N vs x previously found for rare-earth alloys is not obeyed in the Tb–Sc system. (auth)

24661 EFFECT OF PRESSURE ON THE NEEL AND CURIE TEMPERATURES OF THE Tb–Y ALLOY SYSTEM. McWhan, D. B.; Corenzwit, E.; Stevens, A. L. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 37: 1355-6(Mar. 1, 1966).

Measurements of the Néel and Curie temperatures of the alloy system Tb_xY_{1-x} were made from 5 to 90 kbar by an a-c method in which the sample forms the core of a small transformer. The results are compared with similar measurements on the elements Gd, Tb, Dy, and Ho. In the alloy $Tb_{0.95}Y_{0.05}$ the temperature range over which the spiral structure exists ($T_N - T_c$) increases slightly with increasing pressure. For alloys with more than 70% Tb, a transition occurs at high pressure which by analogy to pure Tb is from the hcp to the Sm-type structure. No ferromagnetism is observed in the Sm structure above 77°K. The percent change in T_N at 30 kbar varies smoothly with concentration from 14% in Tb to a constant value of 7% below the 70% Tb alloy. This variation implies that the relation $T_N \propto c^{\frac{1}{3}}$, where c is the concentration of Tb, does not hold at high pressures. (auth)

24662 HIGH-FIELD DESTRUCTION OF THE NON-MAGNETIC GROUND STATE IN TmN. Cooper, B. R. (General Electric Research and Development Center, Schenectady, N. Y.); Jacobs, I. S.; Fedder, R. C.; Kouvel, J. S.; Schumacher, D. P. J. Appl. Phys., 37: 1384-6 (Mar. 1, 1966).

The octahedral cubic symmetry at a Tm site in TmN gives a singlet (nonmagnetic) level as the ground state of the Tm^{3+} ion in the crystal field. Pulsed magnetic fields up to 265 kOe were used to counteract the crystal-field effects and induce large ionic moments. Magnetizations measured at 4.2, 20.4, and 77°K show an approach to saturation at the highest fields used. For 4.2°K, the moment at 265 kOe is 4.5 μ_B per molecule as compared to the saturation value of 7 μ_B. The experimental results for the magnetization and susceptibility are compared to the theoretical results for crystal-field calculations. This comparison allows discussion of the way in which exchange forces enter the magnetization process at high magnetic fields as the ground state becomes polarized. The fourth- and sixth-order crystal-field parameters were evaluated by observing paramagnetic resonance at 9.35 Gc for the $\Gamma_5^{(2)}$ excited triplet. (auth)

24663 MAGNETO-OPTICAL PROPERTIES OF MATERIALS CONTAINING DIVALENT EUROPIUM. Suits, J. C.; Argyle, B. E.; Freiser, M. J. (IBM Watson Research Center, Yorktown Heights, N. Y.). J. Appl. Phys., 37: 1391-7(Mar. 1, 1966).

A variety of relatively transparent materials containing Eu^{2+} have become available, thus enabling a study to be made of the magneto-optical properties of the Eu^{2+} ion in widely different environments. The following materials are reviewed: Eu_2SiO_4 (orthorhombic structure with a ferromagnetic Curie temperature T_c of 7°K), dilute Eu^{2+} in CaF_2 (fluorite structure), EuF_2 (fluorite structure, $T_c \approx 0$), $EuO-Al_2O_3-B_2O_3$ glasses ($T_c = 0$), EuSe (NaCl structure, $T_c = 7$°K), and EuO (NaCl structure, $T_c = 69$°K). The magneto-optical properties of the "nonmagnetic" materials (CaF_2: Eu^{2+}, EuF_2, Eu glasses) are discussed in terms of an intra-atomic $4f^7 \rightarrow 4f^6 5d$ transition. Using this transition, calculation of the Faraday and Cotton-Mouton birefringence in EuF_2 gives reasonable agreement with experiment. The magneto-optical properties of the "magnetic materials" (Eu chalcogenides) are discussed in terms of an interatomic $(4f^7)(4f^7) \rightarrow (4f^6)(4f^7 5d)$ transition. This transition gives reasonable agreement with the observed magnitudes of the magnetic absorption edge shifts in EuSe and EuO. (auth)

24664 SINGLE-CRYSTAL GROWTH AND PROPERTIES OF THE PEROVSKITES $LaVO_3$ AND YVO_3. Rogers, D. B.; Ferretti, A.; Ridgley, D. H.; Arnott, R. J.; Goodenough, J. B. (Massachusetts Inst. of Tech., Lexington). J. Appl. Phys., 37: 1431-2(Mar. 1, 1966).

$LaVO_3$ and YVO_3 are intermediate between $LaTiO_3$ (metallic and Pauli paramagnetic) and $LaCrO_3$ (an insulator and antiferromagnetic below $T_N = 320$°K). Single crystals of these vanadites were grown from the melt by a modified Bridgman technique. The temperature dependences of electric resistivity indicate that both materials are semiconductors in the temperature range 120°–670°K. However, the activation energies for semiconduction are considerably lower than those reported in the literature for powder specimens. Magnetic susceptibilities reveal antiferromagnetic ordering at 137° and 110°K for $LaVO_3$ and YVO_3, respectively. $LaVO_3$ undergoes a structural transition at the Néel point that is suggestive of spin-orbit-coupling electron ordering. These results clearly support a localized-electron model at low temperatures. However, the low activation energies for semiconduction at temperatures above T_N probably reflect a covalent-mixing parameter λ near the critical value λ_c for localized vs collective electron behavior. (auth)

24665 RARE-EARTH COMPOUNDS WITH THE Th_3P_4-TYPE STRUCTURE. Holtzberg, F.; Methfessel, S. (IBM Watson Research Center, Yorktown Heights, N. Y.). J. Appl. Phys., 37: 1433-5(Mar. 1, 1966).

Th_3P_4-type compounds occur in rare-earth systems with elements of Vth and VIth group of the periodic system. In general, the existence of Th_3P_4 compounds appears to be coupled with the formation of 1:1 compounds of the NaCl type in the same system. Analysis of $I\bar{4}3d$ symmetry reveals certain similarities of atomic coordination and distances in both structures. In $RE_{3-x}V_xX_4$ (X = S, Se, Te) ($0 \leqq x \leqq \frac{1}{3}$) the rare-earth ions occupy a defect Th_3 lattice with a random vacancy distribution. With increasing vacancy

concentration x, the materials change continuously from metals to insulators and interesting electric, ferromagnetic, or superconducting properties were observed. The Vth group elements, Sb and Bi, form metallic compounds without a homogeneity range and with the rare-earth ions on the P_4 sites. (auth)

24666 EXCHANGE CONSTANTS AND EFFECTIVE MASSES IN THE FERROMAGNETIC RARE-EARTH METALS. **Darby, M. I.; Taylor, K. N. R.** (Univ. of Durham, Eng.). **J. Appl. Phys., 37: 1442-3(Mar. 1, 1966).**

The value of the term $k_f^4 \Sigma F(2k_f R_n)$ occurring in the RKY theory of indirect interaction was calculated by summing over 1.5×10^5 lattice sites for the six heavy rare-earth metals which exhibit ferromagnetism. The sum $\Sigma F(2k_f R_n)$ has previously been assumed to be constant; however, these calculations show that it varies from -6.62×10^{-3} to -6.91×10^{-3} using free-electron k_f values, or from -2.97×10^{-3} to -7.07×10^{-3} using the k_f values obtained by Yosida. Using these values and experimental results of θ_p and ρ_{spin} the variation of Γ and m^x through the six elements was found. In some instances these new values differ appreciably from those currently accepted. The variation of Γ and m^x with volume was investigated using the results of high-pressure studies, and the values of $\partial \log \Gamma / \partial \log V$ and $\partial \log m^x / \partial \log V$ were found. The change in the g values resulting from these Γ and m^x values is compared with the experimental values. (auth)

24667 MECHANISM FOR THE DIRECT EXCHANGE INTERACTION OF EUROPIUM IN COMPOUNDS WITH ROCKSALT STRUCTURE. **Smit, J.** (Univ. of Southern California, Los Angeles). **J. Appl. Phys., 37: 1455-7 (Mar. 1, 1966).**

From the strong decrease in the nearest-neighbor exchange interaction going from EuO to EuS, EuSe, EuTe, it was concluded that this positive interaction must be caused by direct orbital overlap. Since the 4f cores are very small, this has to occur via partial occupation of outer orbits. The excitation to the 5d wave function by zero point lattice vibrations was considered and is thought to be responsible for the ferromagnetism of these compounds. The order of magnitude was estimated and agrees with experiment. (auth)

24668 COMPOSITION DEPENDENCE OF IRRADIATION-INDUCED UNIAXIAL ANISOTROPY ENERGY OF PERMALLOY FILMS. **Williams, C. M.; Schindler, A. I.** (U. S. Naval Research Lab., Washington, D. C.). **J. Appl. Phys., 37: 1468-9(Mar. 1, 1966).**

The composition dependence of irradiation-induced uniaxial magnetic anisotropy energy was examined in Permalloy thin films over the range from 40% to 90% Ni. The uniaxial anisotropy was developed at 60°C by irradiating the films with 2-Mev ^3He particles in the presence of an orienting magnetic field. The values of the uniaxial anisotropy constant K_u were found to range from a maximum of 1.9×10^4 erg/cm^3 for 52 Ni–48 Fe to a minimum of 1.3×10^3 erg/cm^3 at 90 Ni–10 Fe. In the range from 40% to 70% Ni the values obtained are significantly greater than those found for films evaporated or annealed in the presence of a magnetic field. Because of radiation-enhanced diffusion, directional short-range order can occur at temperatures considerably lower than those necessary for magnetic annealing, with a concomitant increase in the uniaxial anisotropy energy. These data were compared with the theoretical relation, as derived by Néel and Taniguchi, and with a related semiempirical expression of Ferguson: $K_0 = A'(T_c - T_a)n^2(1-n)^2$, where n is the fraction of Fe atoms, T_a is the annealing or deposition temperature, and T_c is the Curie temperature. Both expressions agree with the data fairly well for nickel compositions above 70%, but for compositions of nickel between 40% and 70% the expression developed by Ferguson does not account for all of the observed anisotropy. (auth)

REACTOR TECHNOLOGY

General

Refer also to abstracts 23399, 23602, and 23765.

24669 (ANL–7176) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, FEBRUARY 1966. (Argonne National Lab., Ill.). Mar. 23, 1966. Contract W-31-109-eng-38. 101p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Separate abstracts were prepared for the four included sections. (M.O.W.)

For abstracts of individual sections see: 23640, 23765, 24734, and 24786.

24670 (UJV–1493) LIKVIDACE RADIOAKTIVNICH ODPADU Z VYHORELEHO JADERNEHO PALIVA. EKONOMICKY PREHLED. (Disposal of Radioactive Waste from Irradiated Nuclear Fuel: Economic Survey). Kourim, V.; Korsova, M. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). [1965]. 76p. Dep. mn.

Data published from 1953 to 1964 on the economics of waste disposal are compiled. The work is chiefly from the U.S.A. and Great Britain and is primarily concerned with the economics of the fuel cycle in nuclear power plants and particularly with the processing of high-activity-level wastes for regeneration of burned-up nuclear fuel. Proposed megawatts of installed power for 14 countries in 1970 and 1980 are presented. The methods of disposal are organized under the headings: tank storage; chemical separation, with special attention to the Hanford program; fixation in glass; calcination, including pot calcination; and subterranean storage. Both process and economic data are given for each heading. 56 references. (TTT)

24671 FUTURE NUCLEAR FUEL NEEDS FOR NUCLEAR ENERGY PRODUCTION IN THE GERMAN REPUBLIC, WEST EUROPE, AND THE USA. Troescher, Herbert (Badenwerk Aktiengesellschaft, Karlsruhe, Ger.). At. Strom, 12: 16-19(Jan.-Feb. 1966). (In German).

The development of nuclear energy and fuel material expenditures in the German Federal Republic, West Europe, and the USA was investigated on the basis of present data and simplifying assumptions. Several conclusions were made. According to American data the fuel material price will increase approximately 5 fold up to the year 2000. The present thermal reactors with low conversion factors can be extended with an additional discovery of economic uranium occurences. The earlier mass construction of fast breeder reactors is begun, the longer will the economic uranium sources last. In the transition phase for construction of economic fast breeder reactors, thermal reactors with high conversion factors or breeding capacities can improve the fuel utilization. With small doubling times of the growth rates of fast breeder reactors, the plutonium produced in thermal reactors can no longer be used as a general fuel element. Additional uranium is necessary as fuel material. (tr-auth)

24672 DOES THE GERMAN REACTOR CONSTRUCTION INDUSTRY NEED EXPORT INCENTIVES? Bruechner, H.-J. (AEG-Kernenergieanlagen, Frankfurt am Main). Atomwirtschaft, 11: 162-3(Apr. 1966). (In German).

The German reactor construction industry is now technically competitive with foreign reactor construction industries but with respect to the financial capacities that are so important in large installations and especially in the export of atomic power plants it is severly prejudiced. Therefore it is suggested that suitable steps must be taken to provide export incentives for the German reactor construction industry. (J.S.R.)

24673 ACTIVITIES AND EMISSION POWERS OF FISSION PRODUCTS IN INTERMITTENT REACTOR OPERATION. Kische, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 9: 20-7(Jan. 1966). (In German).

For an intermittent operation of the reactor of 8 hr/day the activities of the gaseous fission products and their daughter products were calculated. After giving a survey of the different methods of determination, the rise after startup of the reactor, the decay after permanent and intermittent operation, and the rise functions of the values appearing between the pauses of intermittent operation of 8 hr/day with the rise of the number of operation periods were determined for the emission powers and the total activities of the fission-product mixtures. The results of other authors concerning the saturated values of the delayed gamma-ray and beta-ray energies released per fission as well as the average energies of gamma rays and beta particles occurring at various times after fission are compared to each other. (auth)

24674 CALCULATION OF PRESSURE TRANSIENTS IN THE VESSEL OF WATER-COOLED REACTORS FOLLOWING LOSS-OF-COOLANT ACCIDENTS. Petrangeli, Gianni. Riv. Ing. Nucl., 3: 797-806(May-Aug. 1965). (In Italian).

A method for the calculation of the pressure transients in the vessel of water-cooled reactors after a loss of coolant accident is described. The method refines and improves some parts of the calculation previously reported and shows some particular characteristics of the problem. The FORTRAN program for the calculation is given. (J.S.R.)

24675 THERMOCHEMISTRY AND NUCLEAR ENGINEERING. Rand, M. H.; Roberts, L. E. J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 3-31 of STI-PUB–109(Vol.1).

Thermochemical data are of value to the nuclear engineer engaged in the preparation of special materials, the design and operation of reactors or the processing of irradiated fuels, both as a tool for the prediction of behavior and as a framework within which results can be correlated. Most of the present reactor types involve the use of solid fissile and fertile metals, compounds or alloys. These may be in the form of rods or plates surrounded by a metal can, or dispersed in a cermet or coated with an impermeable skin. Accurate phase diagrams are required as well as a complete knowledge of equilibria at high temperatures. The lifetime of a fuel is often limited by the chemical and physical changes that occur on irradiation. The direct effects due to irradiation anneal out at high temperatures, but the composition of the fuel changes due to fission. The migration and distribution of fission products depend on their chemical nature and on their behavior in a steep temperature gradient. A start has been made on the analysis of this situation by thermochemical arguments but much more data are required. The use of fluid fuels — either liquid metals or fused salts — requires a very complete knowledge of their thermochemistry. Compatibility problems between structural materials, moderators, control rods and coolants also have to be considered. Many of the components of a reactor core have to last throughout the life of a reactor, 20 years or more. Problems may arise due to the precipitation of impurity phases and of mass transfer down temperature gradients; these may be assessed by thermochemical calculations. The temperatures of operation of these materials are often low enough for considerable radiation damage to occur, and transmutation effects may be appreciable over long periods. The effects of such changes on thermochemical properties is another challenging field. (auth)

Auxiliaries and Components

Refer also to abstracts 23260 and 23991.

24676 (DP–836) DESCRIPTION OF A TEMPERATURE MONITOR FOR LARGE REACTORS. Byrd,

Joseph S.; Dexter, Arthur H.; Goosey, Malcolm H.; Hutter, Carl R.; Leep, Richard W.; Wilson, John N. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Aug. 1963. Contract AT(07-2)-1. 23p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A description is given of a prototype temperature monitor which scans large numbers of thermocouple inputs to provide essentially continuous information on the temperatures of the effluent coolant streams from the fuel assemblies of a liquid-cooled reactor. These temperatures, and computed functions thereof, are compared with stored program values, and alarms are generated if the differences exceed certain preset limits. Readouts are incorporated to permit surveillance and visual determination of the temperature distribution in the reactor. Self-checking features within the monitor minimize the occurrence of erroneous indications or spurious alarms. (auth)

24677 (DPSPU-66-30-3) REACTOR ON-LINE COMPUTER INPUT SIGNAL SYSTEM. Studley, R. V.; Bickley, J. D. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant). Mar. 1966. Contract AT(07-2)-1. 34p. (CONF-660408-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Instrument Society of America, Southeastern Conference and Exhibit, Augusta, Ga.

The reactor on-line computer monitors 3300 analog and 50 switch contact signals. Each signal is switched to a General Electric 412B computer input and measured once every 5 minutes with an accuracy on the order 0.1% of full scale. Thermocouples, with signal levels below 10 millivolts d-c, provide 78% of the signals and differential transformers, with output voltages of about 200 millivolts rms a-c, 17%. The remaining signal sources include resistance thermometers, angular position sensors, flow meters, voltage and current sources, and the outputs of various instruments. The computer accepts two simultaneous analog inputs in ranges of 0 to ±10 or 0 to ±50 millivolts d-c. The large number and variety of input signal sources require 11 different signal conditioning systems, a-c and d-c standards for calibration, and the means to select input signals. The conditioning systems, the circuits, the switches, and an output control circuit are described. (auth)

24678 (NP-15892) NEUERE ERFAHRUNGEN BEIM BETRIEB DER WASSERSSITE DES UNGARISCHEN REAKTORS. (New Experience on the Operation of Water System of Hungarian Reactors). Nagy, Oliver. Nov. 1964. 16p. ORAU.

The latest results in the processing of reactor water are briefly summarized. Proposals are given for improvements in the design of water-processing installations. The factors affecting the quality of water produced by ion exchangers are indicated. (tr-auth)

24679 (ORNL-P-1263) THE NEW ASME SECTION III NUCLEAR PRESSURE VESSEL CODE. Miller, Edward C. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The history of the Boiler Code is reviewed and the contents of Section III are discussed and compared with Sections I and VIII. (W.L.G.)

24680 TWO-IMPELLER ROTARY COMPRESSOR IN NUCLEAR TECHNOLOGY. Sack, D. (Aerzener Maschinenfabrik GmbH, Hameln, Ger.). Atomwirtschaft, 11: 191-2(Apr. 1966). (In German).

The two-impeller rotary compressor can be used for the transportation and compression of gases in reactor operation without additional expenditures on tightness and cleanliness. The special requirements placed on the rotary compressor by helium and radioactive gases are indicated, and their solution is discussed. The tightness testing of the rotary compressors is described. (J.S.R.)

24681 STRESS ANALYSIS OF PLATES AND SHELLS CONTAINING PATTERNS OF REINFORCED HOLES. Bailey, R. W.; Fidler, R. (Central Electricity Research Labs., Leatherhead, Eng.). Nucl. Eng. Design, 3: 41-53 (Jan. 1966).

A study is made of the elastic-stress distribution around a pattern of reinforced holes in a flat plate. Two patterns of penetrations are considered, square and triangular systems, under equi-biaxial applied stress. The present analysis is applicable to tube plates and standpipe entries in concrete pressure vessels. The analysis derives the maximum stress concentration and effective elastic modulus of the plate and these two quantities are presented in the form of curves showing variation with the pitch-to-diameter ratio and degree of reinforcing. The information is thus readily available to the designer. The accuracy of presently used "ligament" theory is discussed. Experimental verification of the analysis is obtained with the aid of a photo-elastic model. Model fabrication and development of adequate loading attachment is discussed. (auth)

24682 THE STABILIZATION OF THE STEEL LINER OF A PRESTRESSED CONCRETE PRESSURE VESSEL. Chan, H. C.; McMinn, S. J. (Manchester Coll. of Science and Tech., Eng.). Nucl. Eng. Design, 3: 66-73(Jan. 1966).

The thin steel liner of a nuclear-reactor concrete pressure vessel is likely to buckle inward as the concrete is prestressed. The case of a hollow cylinder of infinite length is treated. After analysis of the equilibrium states of the shell it is concluded that buckling can be suppressed by anchoring the shell to the concrete with the anchors spaced circumferentially at $S_p = 2.5t/\sqrt{\epsilon}$, where t is the thickness of the shell and ϵ is the circumferential strain imposed by prestressing. The maximum value of ϵ for which no pegging is needed is given by $\epsilon_0 = 0.5(t/R)^{1.2}$, where R is the radius of the vessel. The analysis was verified experimentally. (auth)

24683 DYNAMIC RESPONSE OF SHELL TYPE STRUCTURES SUBJECTED TO IMPULSIVE MECHANICAL AND THERMAL LOADINGS. Zudans, Z. (Franklin Inst., Philadelphia). Nucl. Eng. Design, 3: 117-37(Jan. 1966).

In order to achieve better understanding of impulsive loading effects on shell structures, a dynamic-response-analysis method is developed using continuous shell elements as the mathematical model. The study is limited to the consideration of linear elastic effects. The modal approach is used for the response analysis. An original method, capable of handling large numbers of branched shells, is developed for the analysis of free vibration modes and frequencies. Hamilton's principle, suitably modified to consider the thermal effects, is employed for the analysis of the dynamic response. While the building blocks of the dynamic analysis are the mode shapes of free vibration of the axisymmetric shell model, the response definition is such that structural and mass nonsymmetries can be included. The method as outlined is very general in nature, and efficient for practical applications. At present it is used for the analysis of the dynamic structural response of missiles and re-entry space vehicles, and as well for the analysis of nuclear reactor vessels and internals subjected to axisymmetric time dependent thermal and mechanical loadings. (auth)

24684 ANALYSIS OF AXISYMMETRIC COMPOSITE STRUCTURES BY THE FINITE ELEMENT METHOD. Rashid, Yusef R. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucl. Eng. Design, 3: 163-82 (Jan. 1966). (GA-6763).

The analysis of axisymmetric composite structures by the finite-element method with particular emphasis on the analysis of a prestressed concrete reactor vessel (PCRV) is dealt with. Displacements and stresses in nonhomogeneous elastic structures are obtained by the method presented for any combination of the following loading conditions: body forces, surface and thermal loads, locked-in residual stresses, and prestressing loads. In a PCRV, the conventional steel reinforcement, the prestressing cables, and the steel liner are considered as structural components that contribute to the load-carrying capacity of the over-all structure. The finite-element analysis procedure for an assemblage of axisymmetric

elements which include triangular-ring elements, conical-shell elements, and one-dimensional tension-compression elements is outlined. Analysis results for a pressurized PCRV are presented. (auth)

24685 DYNAMIC RELAXATION COMPARED WITH OTHER ITERATIVE FINITE DIFFERENCE METHODS. Otter, J. R. H. (Rendel, Palmer, and Tritton, London). Nucl. Eng. Design, 3: 183-5(Jan. 1966).

A summary of the results of an analysis of the dynamic relaxation system is presented. It is suggested that for pressure vessels dynamic relaxation is the best choice due to its relative simplicity. (J.F.P.)

24686 IMPROVEMENTS RELATING TO GRAPHITE STRUCTURES IN NUCLEAR REACTORS. Bridge, Harry; Kelly, Brian Thomas (to United Kingdom Atomic Energy Authority). British Patent 1,021,452. Mar. 2, 1966. Filed Jan. 12, 1962.

A method is described for selecting a particular graphite for use in a nuclear reactor that will normally operate at certain predetermined temperature. The graphite is chosen to have different thermal expansion coefficients in regions of different normal operating temperature with the objective of dimensionally stabilizing the graphite under the neutron irradiation. With proper selection of the graphite with reference to the calculated growth and contraction rates the need for complicated structures to allow for the bulk and crystallite dimension changes may be eliminated. (B.L.M.)

24687 HEAT EXCHANGERS AND NUCLEAR REACTOR PLANTS INCORPORATING THE HEAT EXCHANGERS. (to Sulzer Brothers Ltd.). British Patent 1,023,259. Mar. 23, 1966. Priority date Oct. 3, 1963, Switzerland.

A heat exchanger is made up of a number of box-shaped elements, which are of rectangular horizontal cross-section, are closed at the sides by walls, and are open at the top and bottom. Each element contains a number of tube nests for a heat receiving medium disposed side by side. Each tube nest comprises a tube coiled serpentine-fashion in a vertical plane with both the supply and discharge connections at the top or at the bottom of the element. Several different embodiments of the tube nests are described. (B.L.M.)

24688 IMPROVEMENTS IN OR RELATING TO THE CONTROL OF NUCLEAR REACTORS. Banks, Robert (to United Kingdom Atomic Energy Authority). British Patent 1,023,273. Mar. 23, 1966. Filed Nov. 28, 1963.

A control element for operation in a vertical channel in the core of a reactor comprises a series of articulated plates of neutron absorbing material each linked edgewise to its neighbor(s) by pivot means to allow the plates individually to rotate between a position in which the plates are stacked one beside another and a position in which the plates extend edge to edge in a vertical line. Flexible means pass from one end of the series to the other to control this rotation. (B.L.M.)

24689 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Hooper, Alan Thomas; Barker, Kenneth; Pearce, Norman (to United Kingdom Atomic Energy Authority). British Patent 1,023,510. Mar. 23, 1966. Filed Dec. 30, 1963.

Control arrangement for a nuclear reactor includes an intercoupled pair of control members movable in adjacent paths in the core of the reactor. The first member comprises a fuel portion in the core with a nuclear absorbing portion approximately half the length of the fuel portion appended at one extremity of the member and projecting beyond the boundary of the core. The second member comprises a fuel portion coextensive with the fuel portion of the first member in the core and a nuclear absorbing portion appended to the extremity of this second member remote from the extremity of the first member and also projecting beyond the boundary of the core. The means for moving the intercoupled members in opposite directions to introduce the neutron absorbing portions into the core from opposite sides may take any of several forms: rotatable chain type device, hydraulic means connected to pistons on the control members, or a gear system operating on racks associated with both members. (B.L.M.)

24690 SOLID MODERATOR SUPPORTS FOR A NUCLEAR REACTOR HAVING VERTICAL CHANNELS. (to Commissariat a l'Energie Atomique). French Patent 1,192,270. Apr. 20, 1959. Filed Nov. 9, 1957.

A rigid member of tubular shape is interposed, along the axis of a reactor channel, between the moderator-reflector element which limits the lower end of the channel, and the upper end, provided in the support base of the reactor. The member rests upon said support base and is provided at its upper end with a spherical bearing surface adapted to fit and co-operate with a corresponding spherical bearing surface provided at the lower end of moderator-reflector element so as to support it while permitting small relative angular displacements between the member and the element without impairing a fluid-tight connection. (IIB)

24691 APPARATUS FOR LOADING AND UNLOADING NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,310,720. Oct. 22, 1962. Filed Oct. 20, 1961.

The apparatus is particularly adapted to loading or unloading units of plate fuel in the form of parallelopipedal casings, each one of them being provided with a hook which may be grasped by the jaws of a gripping device. The apparatus comprises a horizontal rotatable disc-shaped obturator with a vertical axis of rotation, having two diametrically opposed rectangular apertures. One of the apertures serves for the passage of a plug which, under normal operating conditions, closes an orifice in a cover of the reactor; the other serves for the passage of the nuclear fuel elements of the core. An auxiliary hood is provided for withdrawing and holding the closure plug supported by a movable support which is laterally displaceable by rotation so as to permit access to the orifice. A main hood comprises a rotatable plug on the lower part with a rectangular aperture having the same section as the aperture for the passage of the fuel elements and a control mechanism on its upper part for handling tongs movable inside the hood in a channel having the same section as the rotatable plug aperture. (IIB)

24692 NUCLEAR REACTOR LOADING MACHINE. (to Commissariat a l'Energie Atomique). French Patent 1,327,049. Apr. 8, 1963. Filed Feb. 20, 1962.

Within the shield of a gas-cooled nuclear reactor a lower or main chamber is formed, containing the reactor core, and an upper chamber or "garret" of smaller vertical dimension, separated from the lower chamber by a concrete slab. The fuel-handling unit can be placed within the "garret" so as to scan the horizontal area of a cap containing the upper orifices of charge tubes, by means of an arrangement of polar-coordinate type, including a radially extending monorail rotatable near the top of the "garret" about a central overhead pivot. The fuel handling unit is displaceable through rollers along the length of the monorail. (IIB)

24693 NUCLEAR REACTOR REFUELLING FACILITY. (to Commissariat a l'Energie Atomique). French Patent 1,350,142. Dec. 16, 1963. Filed Dec. 11, 1962.

A system for insertion and withdrawal of fuel elements at high speed is designed. The system permits a rapid transfer of fuel elements between a magazine which is located within the servicing chamber and another magazine which is located outside. The device comprises a lock-chamber occupied by a conveyor which is provided with fuel element compartments and which is movable so as to displace them between a position in which the compartments are located opposite an inlet providing admission to the lock chamber from the servicing chamber and a position in which the compartments are located opposite an outlet from the lock chamber to the exterior. The inlet and outlet are provided with isolating valves and two fuel element storage magazines: the first are intended to be transferred between a location opposite the inlet of the lock chamber and storage locations within the servicing chamber, and the second fuel element magazines which are

intended to be disposed in a location opposite the outlet of the lock chamber. Means are provided for the exchange of fuel elements between the compartments of the conveyor on the one hand and compartments of the first and second magazines on the other hand. (IIB)

24694 HANDLING APPARATUS FOR RELOADING A NUCLEAR REACTOR WITH FUEL ELEMENTS. (to Commissariat a l'Energie Atomique). French Patent 1,366,741. June 8, 1964. Filed Oct. 6, 1962.

A fuel-handling apparatus for a gas-cooled nuclear reactor comprises a beam mounted rotatably about a vertical axis in a garret which is formed inside the biological protection shield and pressure vessel of the reactor. The garret is separated from a chamber occupied by the core by a wall reducing the radiation from the core and having orifices therein permitting access to vertical channels in the core accommodating the fuel elements. Means for rotating the beam about said axis are provided and an assembly is movably adjusted along the beam which assembly carries a vertically movable gripping device. Driving means are arranged outside the shield in a chamber in communication with the garret. Cables extending through the shield connect the movable assembly to driving means and the gripping device. (IIB)

24695 HYDRAULIC TRANSFER FACILITY FOR NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,378,856. Oct. 12, 1964. Filed June 20, 1963.

The irradiation containers are hydraulically transferred between an irradiation station located within the core of a swimming-pool reactor, and a discharge station which is located externally of the pool. The installation comprises a transit tube for connecting the charge station to an extremity of the irradiation station and a circulating tube which is permanently connected to the charge station. A distributor comprises means for providing a communication between one extremity of the irradiation station and the pool water or for isolating one from the other and for connecting the circulating tube either to one or the other extremity of the irradiation station. A circulating pump circulates the water either in one direction or the other within the circulating tube and a compensating tank supplies the tubes with a quantity of purified water which corresponds to the quantity delivered to the pool water through the distributor. The installation permits the possibility of avoiding the passage of activated water into that portion of the circulating system which is located outside the reactor tank while transfer operation is in progress. (IIB)

24696 DEVICE FOR LIFTING AND HOLDING THE THERMOCOUPLE FEED WIRES IN A NUCLEAR REACTOR. Wordworth, Alfred Derrick (to Babcock and Wilcox Ltd.). German Patent 1,202,911. Oct. 14, 1965. Priority date Aug. 19, 1960, Great Britain.

In the fuel element channels and a vessel with standpipes through which the channels may be refuelled in a reactor core, an additional standpipe of smaller diameter was arranged for the passage of the leads of thermocouple means. A magazine for storing the leads in cable form is arranged to be carried on the top of a fuel element while the fuel element is being fed by a refuelling machine into the nuclear reactor and grabbing means are provided on the refuelling machine for extending the cable from the element to a shield plug in the additional standpipe. (Gmelin Inst.)

24697 DEVICE FOR DETACHABLE FIXATION OF TWO COAXIAL STRUCTURAL ELEMENTS TOGETHER. Costes, Didier (to Commissariat a l'Energie Atomique). German Patent 1,203,397. Oct. 21, 1965. Priority date Aug. 16, 1961, France.

The fixing means comprise resilient tongues anchored at one end on the periphery of the first element and engaged at the other end in an inwardly open groove formed in the second element. The radial movement of the free ends of the tongues in the direction that determines their engagement in the groove is caused by their inherent elasticity. Movement in the opposite direction, which determines the removal of the fixing effect, is caused by rods that are arranged transversely and are each articulated at one end to a tongue close to the free end of the latter and by the other end on a common control member capable of being subjected to displacement along the axis of the first element. (Gmelin Inst.)

24698 DEVICE FOR LOADING AND UNLOADING OF THE FISSION ZONE OF A NUCLEAR REACTOR OF FIXED CAPSULES. Erb, Emil; Simon, Helmut (to Gesellschaft fuer Kernforschung mbH). German Patent 1,209,222. Jan. 20, 1966. Filed Aug. 16, 1963.

The transfer device comprises a plurality of reservoirs mounted on a plate and arranged on two concentric circles, the reservoirs on the outer circle serving for the storage of irradiated pellets from the capsules and the reservoirs on the inner circle serving for the storage of new pellets, an arm rotating about the center of the two circles and provided with means for transferring the pellets along the arm, and means outside the circles for connecting the capsules. (Gmelin Inst.)

24699 COLLISION MOMENTUM GENERATOR FOR SHUT-DOWN DEVICES IN NUCLEAR REACTORS. von Mathes, Peter (to Gesellschaft fuer Kernforschung mbH). German Patent 1,210,500. Feb. 10, 1966. Filed Nov. 5, 1964.

The collision momentum generator according to patent 1,151,885 is improved in that the freely movable collision-transferring element located between the face of the shutdown element and the impacting plug of the generator is shorter than the distance between the shutdown element and the generator. Rubber elements press the collision transferring element on the impacting plug. (Gmelin Inst.)

24700 DEVICE FOR IRRADIATING NON-FISSIONABLE MATERIALS AT HIGH TEMPERATURES. Maehara, Tatsuichi (to Mitsubishi Atomic Power Industry, Inc.). Japanese Patent 1964-10675. May 29, 1965. Filed Mar. 14, 1962.

In the reactor experimental (or irradiation) hole, the sample material is surrounded with an inert gas such as helium. The gas is circulated through the interior of the experimental hole, and through a device outside the reactor for controlling the temperature of the gas. In this way the irradiation of nonfissionable materials at high temperatures is made possible. (NSA of Japan)

24701 REACTOR SCRAM SYSTEM. Iwashita, Fumio (to Tokyo Shibaura Electric Co., Ltd.); Seto, Syoji. Japanese Patent 1964-11559. June 9, 1965. Filed Sept. 28, 1962.

The scram system proposed distinguishes between error signals due to noises, etc., and the real scram signal, and is actuated only by the true scram signal. The scram system includes a device that produces a scram signal at the time when the reactor is in danger and a scram electromagnet to shut down the reactor. A control device located between the scram-signal device and the electromagnet under normal conditions energizes the electromagnet to maintain the reactor in operation, and produces a signal to deenergize the electromagnet upon receiving the scram signal. A circuit delays the action of the control device with respect to the deenergizing signal. By suitable selection of the delay time, response of the system to noise signals is prevented. (TCO)

24702 GAS COOLED NUCLEAR REACTOR WITH IMPROVED SHIELD AND CONTROL ROD ARRANGEMENT. Campbell, Ronald Hugh (to United Kingdom Atomic Energy Authority). U. S. Patent 3,239,422. Mar. 8, 1966. Filed Mar. 6, 1961.

In a gas cooled reactor, a pressure vessel encloses the moderator structure, and a neutron shield structure is provided between the pressure vessel and the moderator structure and in close proximity with the moderator structure. The neutron shield structure defines passages for the control rods piercing the neutron shielding. Further provision for neutron shielding is incorporated in the control rods and is disposed in the ends of the rods remote from the moderator structure. (B.L.M.)

24703 NUCLEAR REACTOR HAVING PRESSURE TUBES. Kuenzli, Albert (to Sulzer Brothers Ltd.). U. S. Patent 3,240,677. Mar. 15, 1966. Priority date June 13, 1962, Switzerland.

A pressure tube and fuel rod arrangement is patented that provides for uniform coolant flow around the fuel rods, provides protection of the pressure tube from excessive heat, and utilizes the space within the tube not used for fuel for moderation. Shapes made of moderator material are placed inside the tube and between the fuel rods. These shapes are provided with bores or channels for conducting the coolant and for accommodating the fuel rods. (B.L.M.)

Criticality Studies

Refer also to abstracts 24313 and 24755.

24704 (AD–627892) THE FLAME PROGRAM REFERENCE MANUAL. Cuthill, E.; Kenady, S.; Schot, J.; Mejia, R.; Gibson, B. (David Taylor Model Basin, Carderock, Md. Applied Mathematics Lab.). Jan. 1966. 274p. (DTMB–1939). CFSTI $6.00 cy, $1.50 mn.

The programming details are described of all the routines comprising FLAME, a set of UNIVAC-LARC codes which solve a variety of steady-state and time-dependent problem pertaining to the behavior of nuclear reactors. The logic and functioning of the entire program are presented and then each routine is described separately. The many aspects of the code which involve a special attention to detail, such as the content and handling of all data files, the repeated usage of all storage devices, the significance of the controlling parameters, and the flow of the logic for all types of problems, are summarized in charts and tables to facilitate maintenance and complete the documentation of the program. (auth)

24705 (AD–627969) THE FLAME OPERATIONS MANUAL. Report No. 1938. Cuthill, Elizabeth; Lundgren, Corinne; Schot, Joanna W.; Kenady, Sarah E. (David Taylor Model Basin, Carderock, Md. Applied Mathematics Lab.). Dec. 1965. 111p. CFSTI $4.00 cy, $0.75 mn.

The operational features to be followed in setting up and running FLAME production problems on the DTMB UNIVAC-LARC computing system are described. The three versions of the FLAME Code in production, FLAME 1, FLAME 2, and FLAME 3, solve three-dimensional reactor depletion problems, two-dimensional steady-state problems, and three-dimensional steady-state problems, respectively. Both standard and special procedures for running these codes are described. Detailed reference charts and figures to illustrate the use of the operating system for production runs are included. (auth)

24706 (AECL–2523) LATTICE MEASUREMENTS WITH 19-ELEMENT NATURAL URANIUM METAL ASSEMBLIES. PART II. RELATIVE TOTAL NEUTRON DENSITIES AND HYPERFINE ACTIVATION DISTRIBUTIONS IN A LATTICE CELL. Serdula, K. J. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Dec. 1965. 55p. Dep. mn. AECL $1.50.

Relative total neutron densities and hyperfine Mn-wire activation distributions are derived from measurements in the central cell of a triangular array of 55 19-element natural uranium metal assemblies in the ZED-2 reactor. Results are presented for lattice pitches of 20, 24, 28, and 40 cm. "Coolants" used were, (1) D_2O of moderator purity, and (2) air to simulate loss of coolant condition. Data indicated that the neutron-density depression in the cell is less upon loss of coolant. (auth)

24707 (CONF-660303–6) CROSS SECTION SENSITIVITY CALCULATIONS FOR SMALL HYDROGEN MODERATED SYSTEMS. Weinstein, S.; Feiner, F.; Cooper, K. V.; Armstrong, S. I. (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 22, 1966. Contract W-31-109-eng-52. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C.

Experiments were performed with the KAPL Solid Homogeneous Assembly. The cores built on the assembly are leakage dominated and were designed to have an enhanced sensitivity to high energy cross sections. Sensitivity calculations were made using evaluated microscopic cross sections for oxygen, zirconium, carbon, and uranium-235. (M.O.W.)

24708 (KFK-382) ZUR FRAGE DER BESTIMMUNG NEUTRONENPHYSIKALISCHER GROESSEN VON NATRIUMGEKUEHLTEN SCHNELLEN BRUTREAKTOREN MIT DER SNEAK-2-ANORDNUNG. (The Problem of Determining the Neutron Physics of Sodium Cooled Fast Breeder Reactors using the SNEAK-2 Assembly). Durand-Smet, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Nov. 1965. 52p. Dep. mn.

The following theoretical and practical problems which arise in the simulation of the large fast breeder reactors are described: technique of two-zoned assemblies, effects of the material inhomogeneity, methods of calculation, and replacement of an expensive material by a mixture of two cheap materials. The SNEAK-2 Assembly is thus described and the essential neutronic properties (criticality factor, extrapolated dimensions, reactivity worth of materials at the center of the assembly) are indicated. These properties were calculated in spherical or cylindrical geometry with the help of the 16-group-YOM-set and the 26-group-ABN-set. The safety coefficients are also given. The effects of sodium voiding are investigated in detail. Various considerations lead to the definition of three different sodium-coefficients: first, the local danger coefficient, which has to be determined in each point of the core-axis and of the radial direction; secondly, the void-coefficient, which has mainly to be determined in large central zones of the core; and finally the density-coefficient of sodium in core, which concerns the effect of an homogeneous voiding of sodium in the whole core. These three coefficients are calculated. (M.O.W.)

24709 (RPI–328-52) SUBCRITICAL REACTIVITY DETERMINATIONS—COMPARISON OF EXPERIMENTAL METHODS. Gozani, Tsahi (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science). [1965]. Contract AT(30-3)-328. 7p. (CONF-660606–1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Nuclear Society Meeting, Denver.

Four methods of measuring the reactivity of subcritical systems are discussed and compared. (D.C.W.)

24710 (WAPD-T–1914) RECENT DEVELOPMENTS IN THE ANALYSIS OF NEUTRON NOISE EXPERIMENTS. Natelson, M.; Osborn, R. K.; Shure, F. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Feb. 1966. Contract AT(11-1)-Gen-14. 25p. (CONF-660206–4). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Symposium on Neutron Noise, Waves, and Pulse Propagation, Gainesville, Fla.

An analysis of space and energy effects in neutron noise experiments is carried out. In particular influences of detector and reactor configuration and neutron slowing down on power spectral-density, cross power-spectral density and variance-to-mean measurements are considered. In the process an explanation is given for the success of a space and energy independent description for a large class of systems on which such experiments are performed. A specific expression for detector efficiency is obtained. Thus experimental limitations for noise experiments are also considered. (auth)

24711 (WAPD-TM–564) THE NUMERICAL SOLUTION OF THE REACTOR KINETICS EQUATIONS BY DIFFERENCE ANALOGS: A COMPARISON OF METHODS. Porsching, T. A. (Bettis Atomic Power Lab., West Mifflin, Pa.). Mar. 1966. Contract AT-11-1-GEN-14. 44p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The results of a study of six difference analogs which were used to generate numerical solutions of the Reactor Kinetics Equations are presented. Each analog was studied from the point of view of the accuracy of its so-

lution and the time required to generate the solution. The appendix presents a mathematical development of one of these analogs. (auth)

24712 CRITICAL ANALYSIS OF EXPERIMENTAL APPARATUS FOR NOISE-POWER SPECTRUM MEASUREMENTS IN NUCLEAR REACTORS. Garroni, A.; Lucia, A. (CCR-EURATOM, Ispra, Italy). Energ. Nucl. (Milan), 13: 105-21(Mar. 1966).

Errors due to instrumentation, arising in measurements of the noise-power spectral density in nuclear reactors, are analyzed. Various theoretical and experimental compensation methods are considered, as well as the corresponding measurement procedures. Separate consideration is given to errors of the following five main types: (a) errors due to superimposed spurious signals, (b) errors due to instrumentation non-linearities, (c) errors connected with the frequency response of instrumentation, (d) errors due to the filtering-detection system of the spectrum analyzer, and (e) statistical measurement errors arising from the random nature of the quantities being analyzed. (auth)

24713 MEASUREMENT OF THERMAL DIFFUSION CONSTANTS FOR LATTICE ARRANGEMENTS WITH VOIDS. Heer, W.; Lutz, H. R. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Neue Tech., 7: 296-309(Dec. 1965). (In German).

Thermal diffusion constants for D_2O-moderated lattices of empty Al tubes, as well as of gas-cooled UO_2, cluster type fuel elements were measured in the subcritical facility MINOR, using the method of Benoist and Palmedo. Results obtained for the UO_2 clusters are compared with diffusion constants determined experimentally in the Swedish zero power reactor RO by the method of Persson. In addition, diffusion constants, calculated by the method of Behrens and Benoist, are presented. (auth)

24714 IMPROVED CALCULATION METHODS FOR RATIOS APPEARING IN REACTOR STATICS. Lewins, Jeffery (Univ. of Washington, Seattle). Nucl. Energy, 69-76(Mar. 1966).

Variational and perturbation expressions are developed from which to calculate ratios of interest in either critical systems or in sub-critical systems having a source. The several adjoint functions employed are related to the physical concept of the importance. The emphasis is placed on the calculation of the adjoint functions by iterative methods that are already standard in reactor codes. The expressions given can improve the accuracy of results while requiring substantially less computing time than conventional direct calculations. (auth)

24715 NONLINEAR STUDY OF REACTORS WITH A LINEAR FEEDBACK. Akcasu, A. Ziya; Noble, Larry D. Nucl. Sci. Eng., 25: 47-57(1966).

Solutions of the point kinetic equations with delayed neutrons for reactor systems with arbitrary linear feedback are investigated. It is found that the solutions that are Laplace transformable are bounded for all initial perturbations regardless of whether or not the system is linearly stable, provided the Laplace transform of the feedback kernel has no zeros on the positive real axis. This criterion is applied to some reactor models previously investigated. It is shown that there are also nontransformable solutions that possess a finite-escape time and that such solutions can exist only if the reactor has a prompt positive reactivity coefficient. The asymptotic behavior of these solutions near the escape time is also obtained. These general conclusions are verified by considering some specific feedback models for which exact solutions are available. Numerical solutions for reactor systems with more realistic feedback models, such as one used to describe EBR-I, are obtained by a digital computer. (auth)

24716 RANDOM PROCESSES OF A NUCLEAR REACTOR AND THEIR DETECTION. Dalfes, Abdi (Technical Univ. of Istanbul). Nukleonik, 8: 94-101(Feb. 1966).

The fundamental equation which gives the probability generating function of the Markovian processes occurring in a zero-power point reactor and containing neutron detectors is first set up, and then the equations relating the expected values, covariances, and correlation functions of the state variables are obtained from the fundamental equation in matrix form. The equations for the covariances and correlation functions are solved by assuming a stationary subcritical reactor. From their solutions the correlation functions and power spectral densities of the detector outputs are deduced. Also given is the probability generating function of the detector outputs when delayed neutrons are ignored. (auth)

24717 FLUX CALCULATIONS WITH THE MODIFIED KANTOROWITSCH METHOD. Schaeffler, Hermann (Technische Hochschule, Stuttgart). Nukleonik, 8: 119-20 (Feb. 1966). (In German).

It was shown that the modified Kantorowitsch method is well suited for the calculation of neutron fluxes in non-separable reactor geometries. Numerical results were given as a function of the approximation and compared with the difference method. (tr-auth)

24718 METHOD OF MEASURING THE PERIOD OF A NUCLEAR REACTOR. (to Commissariat a l'Energie Atomique). French Patent 1,000,843. Sept. 21, 1964. Filed May 17, 1963.

The method consists in integrating the value of the current i produced by an ionization chamber located near the core of the reactor during two equal successive intervals of time θ and relating the two results. Thus, the measurement of two predetermined areas is effected in a system of coordinates where time is on the abscissas, and current on the ordinates between the curve i(t), the abscissa axis and the parallel straight lines of the ordinate axis separated by intervals corresponding to times equal to the size θ adopted. (IIB)

Design and Feasibility

24719 NUCLEAR REACTOR INSTALLATIONS WITH STEAM AS HEAT TRANSFER MEDIUM IN PRIMARY CIRCUIT AND WATER OR STEAM AS WORKING MEDIUM IN SECONDARY CIRCUIT. Acklin, Leo (to Gebrueder Sulzer AG). German Patent 1,209,674. Jan. 27, 1966. Priority date Mar. 3, 1960, Switzerland.

The nuclear reactor installation comprises a reactor, a primary circuit containing steam as a heat transfer fluid, which is superheated by the heat of the reactor, and removes heat therefrom, and a secondary circuit containing water or steam as a fluid medium, which is at a higher pressure than the steam of the primary circuit and receives heat from the steam of the primary circuit in a heat exchanger, the two circuits being interconnected by at least one pipe including a throttle valve controlled by a pressure regulating element. (Gmelin Inst.)

24720 NUCLEAR REACTOR. Junkermann, Wolfgang; Steinert, Christoph; Schmale, Joachim (to Deutsche Babcock and Wilcox-Dampfkessel-Werke). German Patent 1,210,498. Feb. 10, 1966. Filed Oct. 24, 1964.

The arrangement comprises a closed pressure vessel, a hollow open-topped cylindrical chimney mounted vertically within the pressure vessel extending up from the bottom of the pressure vessel and forming an annular chamber with the wall of the pressure vessel, a reactive core with vertical coolant passages located in the lower central portion of the chimney, pump means mounted external and adjacent to the pressure vessel establishing primary coolant flow up through the core and chimney and down through the annular space, and vapor generation means mounted in the annular space and surrounding the chimney for receiving heat from the primary coolant. Part of the reactor coolant entering the core is branched off, flows through the separate moderator space, and is again introduced into the coolant flow in one of the cooler sections of the vapor generation means. (Gmelin Inst.)

Fuels

Refer also to abstracts 23637 and 23771.

24721 (SGAE-M-4/1966) MESSUNG DER OBERFLAECHENVERUNREINIGUNG VON BESCHICHTETEN

TEILCHEN DURCH SPALTBARES MATERIAL. (Measurement of the Surface Contamination of Coated Particles by Fissionable Material). Buchner, K. H.; Koss, P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). 1966. 25p. Dep. mn.

The surface contamination of coated particles was determined by measurement by the α radiation of the particle surface and by measurement of fission products arising by fission recoil from surface. The results of the two methods were compared, and the fission product method was found to be superior to the α measurement method. (J.S.R.)

24722 IMPROVEMENTS RELATING TO NUCLEAR FUEL ELEMENTS. Alfille, Lucien; Briola, Jean; Chambaud, Bernard; Dufresne, Jacques (to EURATOM). British Patent 1,021,900. Mar. 9, 1966. Priority date Mar. 7, 1962, Belgium.

A matrix is described for a fuel element of the cluster type that includes a number of fuel pencils. The matrix is made of a material having a low neutron absorption coefficient and having elongated sub-channels for the reception of the fuel pencils. The matrix is formed in identical blocks having a cross sectional shape of a circular sector so that the blocks may be assembled into a cylinder. The blocks are held together with resilient or deformable means for pressing the blocks against one another. The resilient means consists of metallic rings, and the deformable means may consist of a heat insulating band wound around the matrix. (B.L.M.)

24723 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Hargo, Bernt Torsten Allan. British Patent 1,023,133. Mar. 23, 1966. Priority date Mar. 9, 1962, Sweden.

An elongate fuel element for a reactor of the pressurized water type using heavy water as both moderator and coolant is patented. The nuclear fuel extends longitudinally over substantially the length of the element and is disposed within a number of coolant passages, which are arranged to extend parallel to the longitudinal direction of the element. Each coolant passage extends over only a portion of the length of the element, and the passages are separate from each other and have port means arranged so as to divide the coolant flow into a number of parallel streams. Each stream passes through a separate coolant having a main direction of flow parallel to the longitudinal direction of the element. (B.L.M.)

24724 ELEMENT OF FISSIONABLE MATERIAL. (to Escher Wyss S.A.). French Patent 1,196,192. Nov. 23, 1959. Priority date May 31, 1957, Switzerland.

Fissionable material of the fuel element is disposed in the form of an agglomerate in the space between two tubular bodies of heat-resistant material which are formed with radial apertures and are arranged one within the other. Both bodies are arranged within a third hollow body. The gaseous heat carrier can be fed through the space between the wall of the third hollow body and the outer one of the two tubular bodies, then pass out of this space to the fissionable material through the radial apertures in the outer tubular body. Thereafter the gas passes through the radial apertures in the inner tubular body into the interior of this body from which in turn it can be discharged. (IIB)

24725 METHOD OF MANUFACTURING AND USE OF FUEL ELEMENTS FOR NUCLEAR REACTOR. Schludi, Harry Norman. French Patent 1,285,735. Jan. 15, 1962. Priority date Apr. 14, 1960, Germany.

In order to avoid fracture of the fuel elements comprising a casing containing fissionable material, heat is supplied to the fuel elements from an energy source independent of the nuclear reactor whenever the power of the reactor is reduced to a level below which the temperature of the casing approaches a predetermined minimum temperature. (IIB)

24726 FUEL ELEMENT FOR A NUCLEAR REACTOR. (to Sulzer Freres S.A.). French Patent 1,287,558. Feb. 5, 1962. Priority date Mar. 15, 1960, Switzerland.

An oblong can closed at one end contains a plurality of fuel tubes through which a coolant flows in one direction. The coolant flows in the opposite direction through the spaces between the fuel tubes or between the fuel tubes and the inside of the can. Thus, the entire interior of the can is under pressure of the coolant and not more than a single high pressure seal is required. The connections of the fuel tubes inside the can need not be absolutely tight and the tubes may simply be telescoped one into the other. (IIB)

24727 CELL FOR HEAT EXCHANGER. (to Comissariat a l'Energie Atomique). French Patent 1,321,570. Feb. 11, 1963. Filed Feb. 8, 1962.

A tubular fuel-element cell comprises an external liner divided into two portions of substantially the same length by an intermediate partition extending at right angles to the cell axis and intermediate the cell ends. Each one of said two portions has an inlet duct for a cooling fluid in the liquid phase. A plurality of tubular fuel elements is disposed symmetrically at spaced intervals about the axis of the cell in order to vaporize the fluid. The inlet duct and the vaporization elements are connected in the vicinity of the intermediate partition by means of radial ducts having a nozzle-like tapered configuration adapted on the one hand to throttle the liquid phase and on the other hand to form a liquid film on the inner wall of the fuel elements. The film flows in the axial direction with a helical motion along the walls of fuel elements. (IIB)

24728 FUEL ELEMENT FOR PRESSURE-TUBE NUCLEAR REACTORS. Alfille, Lucien; Briola, Jean; Dufresne, Jacques; Ohlmer, Eggert (to EURATOM). German Patent 1,207,518. Dec. 23, 1965. Priority date Apr. 17, 1962, Italy.

The fuel element comprises a plurality of laterally spaced rods extending between a top hanger and a bottom spacer, a pressure tube surrounding the rods through which the coolant is circulated, and a heat insulating layer in the annular space between the pressure tube and a guide tube disposed concentrically within the pressure tube. (Gmelin Inst.)

24729 GAS-TIGHT NUCLEAR FUEL ELEMENT STANDING UNDER INCREASED INNER PRESSURE AND METHODS OF ITS PRODUCTION. Schulze, Joachim; Goebel, Ralf (to Zentralinstitut fuer Schweisstechnik). German Patent 1,209,673. Jan. 27, 1966. Filed May 9, 1961.

The fuel element comprises a sheath, the end of the sheath being closed by a cap secured in position in the ends of the sheath by a sealing weld. The end cap is provided with an axial perforation closed by a non-return valve. The method of fabrication comprises the steps of securing the end cap in position by a sealing weld, of introducing an inert gas into the fuel element sheath through the perforation in the end cap via the non-return valve until the desired pressure is obtained, of removing the filling device, and of closing the end cap by a sealing weld. (Gmelin Inst.)

24730 SPHERICAL FUEL ELEMENT FOR HIGH-TEMPERATURE POWER NUCLEAR REACTORS AND METHOD FOR PRODUCTION OF THE SAME. Rachor, Lothar; Lotz, Horst (to NUKEM). German Patent 1,210,095. Feb. 3, 1966. Filed Sept. 5, 1963.

The spherical fuel element according to patent 1,202,910 comprising a central graphite core and a fuel inner cladding is improved in that the core is cylindrical in shape. (Gmelin Inst.)

24731 SPHERICAL FUEL ELEMENT FOR HIGH-TEMPERATURE POWER NUCLEAR REACTORS. (to NUKEM). German Patent 1,210,096. Feb. 3, 1966. Filed Sept. 5, 1963.

The spherical fuel element according to patent 1,202,910 comprising a graphite core and a fuel inner cladding is improved in that the core is disposed eccentrically away from the filling plug so that the wall adjacent to the plug is reinforced. (Gmelin Inst.)

24732 BUNDLE-TYPE NUCLEAR FUEL ELEMENT HAVING NOVEL ARRANGEMENT OF FISSIONABLE AND

FERTILE MATERIAL. Deddens, James C.; Barringer, Howard S. (to Babcock and Wilcox Co.). U. S. Patent 3,238,108. Mar. 1, 1966. Filed Apr. 17, 1959.

A fuel element arrangement for a heterogeneous reactor is described whereby localized power peaking in the flow channels is reduced. The fuel element is made up of a number of separate laterally spaced elongated fuel components containing a mixture of fissionable and fertile material arranged in a geometric pattern to form a bundle having a polygonal transverse cross section. The peripheral components bounding the transverse cross section of the bundle have a lower fissionable material content than the interior components. The corner peripheral components contain a mixture of fissionable and fertile material at each end and fertile material in the section between. These fuel bundles are arranged in a flow channel in the reactor having substantially the same cross section as the fuel bundles and having a coolant inlet at one end and an outlet at the other end. Each fuel pin in the bundle is made up of cylindrically shaped fuel pellets containing a mixture of fertile and fissionable material arranged within an elongated open ended tube of circular cross section. A metallic insulating pellet is positioned at the end of the fuel pellets within the tube, and end caps provide sealed closures. (B.L.M.)

Power and Power-Breeder Reactors

Refer also to abstracts 23796 and 23998.

24733 (ACNP–66522) ELK RIVER REACTOR OPERATIONS ANALYSIS PROGRAM. FUEL CYCLE STUDIES FOR SECOND CORE: TASK 201. Fisher, J. R.; Kendrick, E. D. (Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.). Mar. 1966. Contract AT(11-1)-1357. 67p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Major emphasis was placed on a three-batch loading cycle of Core II elements. The effect of varying the size of the discharge group as well as incorporating the 20 Core I spares into the feed patterns was investigated. Various core arrangements and exposure rates were determined. Conclusions and recommendations are given. (M.O.W.)

24734 (ANL–7176, pp 1-44) LIQUID-METAL-COOLED REACTORS. (Argonne National Lab., Ill.).

A summary of modifications made on the EBR-II during February is presented. A detailed description is given of assembly 47 of ZPR-3, a mockup of SEFOR at reactor loading No. 15, the loading at which the assembly was first critical. Radial fission measurements were made in the assembly. Spectral indices, reactivity worth, ratio of ^{238}U capture to ^{235}U fission, and Doppler effect measurements were made. Reactivity measurements were also made as a function of time in the ZPR-6 assembly 4Z. Studies were made on fast reactor fuel development concerning various aspects of PuC–UC fuels and V–Ti–Cr cladding. Burnup measurements were made for approximately 70 different fuel configurations. Developments in fuel reprocessing are reported. A brief discussion on the performance of Nicrobraz and 304-stainless steel tubing in 1200°F sodium is presented. (M.O.W.)

24735 (BNWL–234) FCC—A FUNDAMENTAL MODE CODE FOR FAST REACTOR ANALYSIS. Little, W. W. Jr.; Hardie, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1966. Contract AT(45-1)-1830. 126p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

A computer program (FCC) that calculates resonance shielded cross sections, collapsed group cross sections, fuel burnup, and the fundamental-mode flux and adjoint flux is described. A FORTRAN IV source deck listing, input information, and a sample case are included. (D.C.W.)

24736 (EACRP–U–16) PROCUREMENT OF REACTOR PHYSICS DATA FROM OPERATING POWER REACTORS. Eriksen, V. O. (Institutt for Atomenergi, Kjeller (Norway)); Went, J. J. (Keuring van Electrotechnische Materialen, N. V., Arnhem (Netherlands)). [1964]. 28p. Dep. mn.

The value of physics experiments in power reactors is discussed. A review of pre-startup experiments is presented, and measurements of flux and power distributions are discussed. Reactor control, operating performance, and fuel burnup problems are considered in some detail. (D.C.W.)

24737 (ORNL–P–2052) A POTASSIUM-STEAM BINARY VAPOR CYCLE FOR A MOLTEN-SALT REACTOR POWER PLANT. Fraas, A. P. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 35p. (CONF-660313–1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Society of Mechanical Engineers, Gas Turbine Conference, Zurich.

A conceptual design for one embodiment of a binary vapor cycle coupled to a molten-salt reactor has been prepared to determine whether such a plant is sufficiently attractive to warrant further investigation. Its overall thermal efficiency is estimated to be 54%, while its heat rejection to the condensers is about half of that for a modern steam plant. The quantities of material required for the heat exchangers and piping for both a coal-fired supercritical-pressure steam plant and a nuclear-powered potassium vapor and supercritical-steam plant are estimated and compared along with the associated costs. The resulting cost and performance data indicate that the nuclear plant with a potassium-vapor and steam binary cycle may give both lower capital charges and a much higher overall efficiency than a coal-fired supercritical-pressure steam plant. (auth)

24738 (PEL–97) NUCLEAR POWER ECONOMICS. A Bibliography Covering 1963–1965. Rossouw, S. F. (comp.) (Atomic Energy Board, Pelindaba (South Africa)). Jan. 1966. 118p. Dep. mn.

A bibliography containing 297 abstracts on the factors influencing the competitivity of nuclear reactors for electric power production is presented. A chapter is included on the economics for water desalination. (M.O.W.)

24739 (WCAP–6073) LASER—A DEPLETION PROGRAM FOR LATTICE CALCULATIONS BASED ON MUFT AND THERMOS. Poncelet, C. G. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Apr. 1966. Contract AT(30-1)-3017. 104p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

LASER is a one-dimensional (cylindrical), multi-energy (85 groups) lattice-cell program which is based on the MUFT and THERMOS codes. The thermal cutoff is 1.855 ev. A burnup option is provided. The program will, at option, account for the nonlinear effects in the burnup equations. The spatial burnup distribution within the fuel rods is explicitly calculated. The output is quite extensive and includes, in addition to the normal edits, an edit for the energy range $0 \leq E \leq 0.625$ ev. The physical and mathematical formulations of the model are outlined and a general description of the program, including a description of the input and output data is included. LASER is written in FORTRAN IV for the IBM 7090/7094/7094. (auth)

24740 DESALTING OF SEA WATER BY NUCLEAR POWER. Koppe, Johannes (Hamburgische Electricitaets-Werke Aktiengesellschaft, Hamburg). At. Strom, 12: 12-15(Jan.-Feb. 1966). (In German).

The development of suitable economic methods for the desalination of sea water is discussed. It is proposed that nuclear reactors can be used as energy sources for desalting installations because of their low fuel costs in large installations. Combined plants with simultaneous water desalination and current production offer the best economic potentials. (P.C.H.)

24741 MODEL INVESTIGATIONS ON THE FUTURE AND CONSEQUENCES OF THE USE OF NUCLEAR ENERGY FOR ELECTRICITY PRODUCTION. Harde, R.; Memmert, G. (Internationale Atomreaktorbau GmbH, Bensberg, Ger.). Atomwirtschaft, 11: 164-70(Apr. 1966). (In German).

In forecasts on the long-term significance of nuclear energy, the evaluation criteria of the various reactor types make more or less arbitrary assumptions. The use of models in the study of the future and consequences of nuclear energy does away with most of these assumptions. The principles of such model studies, the initial viewpoints and assumptions, and the questions to be asked in such studies are indicated. The methods used for the derivations of the cost equations, the dependence of the current production costs on plutonium value, and the length of the time step are derived. The data used in the calculations are tabulated. (J.S.R.)

24742 VIEWPOINT FOR THE INTERPRETATION FOR THE ELECTRICAL EMERGENCY INSTALLATION FOR NUCLEAR POWER PLANTS. Reik, M. (Technischer Ueberwachungs-Verein Bayern, Munich). Atomwirtschaft, 11: 188-90(Apr. 1966). (In German).

The factors to be considered in designing the emergency supply system for a nuclear power plant are reviewed. The reactor areas that must be supplied, the supply of the emergency generator, construction of the emergency generator, and construction of fail-safe emergency nets are considered. (J.S.R.)

24743 ADVANCING TECHNOLOGY OF THE PRESSURIZED WATER REACTOR. Kilpatrick, J. N.; Beal, F. S. (Westinghouse Atomic Power Div., Pittsburgh). EuroNuclear, 3: 127-31(Mar. 1966).

A description is presented on the recent advances and future possibilities of the pressurized water reactor concept for central station nuclear power plants. The major areas responsible for the advancement of PWR technology are discussed. These areas are increased size and improved performance of major plant components, improved core performance, and improved technology. (B.G.D.)

24744 THE IMPORTANCE OF NUCLEAR ENERGY IN THE ELECTRICITY ECONOMY IN THE GDR. Fuchs, Klaus. EuroNuclear, 3: 132-4(Mar. 1966).

An outline of recent research and development programs in the field of nuclear energy in the German Democratic Republic is presented. These programs are classified into two groups. The first group comprises the supporting work for the construction and operation of the first and second atomic power stations, and the second includes the work which will establish the preliminary scientific-technical work for future atomic power stations, considering international trends of development and the political and economic needs of the GDR. A trend toward the early development of fast breeder reactors is indicated. (B.G.D.)

24745 FUEL HANDLING EQUIPMENT AT THE TOKAI POWER STATION. Kushima, Takashi (Fuji Electric Manufacturing Co., Japan). FAPIG (Tokyo), No. 37, 107-11(July 1965). (In Japanese).

A detailed description is given of the fuel handling equipment at the Tokai power station used for treatment of used fuel and loading of the required new fuel. The equipment consists of the preparation room for fuel loading, fuel separating devices, dry sealing devices, rehearsal facility, manipulating sleeves, emergency release channels, radioactive hose storages, and radioactive waste storages. Cylinders driven by CO_2 gas are mostly employed for actuating the various members. The handling of the new and spent fuels is done in the loading-machine control room. (tr-auth)

24746 COMMUNICATIONS AND COMMAND FOR A LUNAR NUCLEAR POWER PLANT. Morris, Vernon B. Jr.; Hanson, William A.; Somers, G. William. Contract DA-49-129-ENG(NASA)-1. pp 57-67 of 1965 International Telemetering Conference Proceedings. [Pasadena, Calif., F G McGavock Associates], 1965.

Extensive lunar exploration will require the establishment of relatively long-term lunar bases. The power demands and the high fuel transportation costs to support these bases will necessitate the utilization of nuclear power plants. The lunar base is briefly described. The economics of electrical power production on the moon are discussed and the need for a nuclear power plant is established. A power plant configuration is shown. Communications and command requirements are presented and the communications and command system is described. (auth)

24747 ESTIMATION OF THE EARTHQUAKE ACCELERATION AND MEASUREMENT OF THE VIBRATIONS CAUSED BY EARTHQUAKES, FOR THE JPDR CONTAINMENT VESSEL STRUCTURE. Tajimi, Hiroshi (Nihon Univ., Japan); Ichino, Ichiro. J. Jap. Soc. Mech. Eng., 68: 1013-19(Aug. 1965). (In Japanese).

The Japan Power Demonstration Reactor is contained in a steel pressure vessel constructed by welding and made up of a cylindrical body and a semispherical top part. Calculations were made of the natural period, damping coefficient, and response multiplication factor at different points for the vessel structure, based on the particular foundations used and earthquakes in Tokai-Mura. The acceleration acting at each part of the structure was also calculated and was found to be less than the degree of seismicity employed in the design. After completion of the JPDR, acceleration meters, displacement meters, etc. were installed at different parts of the structure, and the vibration behavior was measured. The natural period, rocking center, etc. obtained from these measurements by March 1964 showed good agreement with the calculated values. (TCO)

24748 STUDIES WITH PLUTONIUM-FUELED CORES IN THE ZERO-ENERGY, HIGH-TEMPERATURE NUCLEAR REACTOR ZENITH. Cameron, I. R. (United Kingdom Atomic Energy Authority, Winfrith, Eng.); Drageset, A.; Freemantle, R. G. J. Nucl. Energy, Pt. A/B, 20: 285-311 (Apr. 1966).

A series of experiments carried out with plutonium fuel in the heated zero-power reactor Zenith are described, with the aim of testing current theoretical methods, with particular reference to excess reactivity, temperature coefficients, differential spectrum and reaction-rate distributions. Two cores of widely different fissile/moderator atom ratios were loaded in order to test the theory under significantly varied spectrum conditions. The general agreement is comparable with that found for the ^{235}U cores previously investigated. (auth)

24749 PROBLEMS RAISED IN THE USE OF PLATES FOR THE VESSELS OF E.D.F. I AND E.D.F. II NUCLEAR POWER STATIONS. Petiau, M.; Borione, R. Met. Constr. Mec., 96: 773-4; 777; 779; 781(Oct. 1964).

Problems raised by the dimensions of the vessels and the thicknesses of the plates (up to 115 mm) are discussed. The preheating, welding, stress relieving, and weld inspection operations are described. (UKAEA)

24750 ASPECTS OF SAFETY, IN PARTICULAR OF CONTROL CELLS, FOR THE PRINCIPAL TYPES OF POWER REACTORS. Buclin, J.-P. Neue Tech., 8: 8-19 (1966). (In French).

In general terms, it is first shown how the control of a thermal power station of conventional or nuclear design can contribute to safe operation. The more specific aspects of instrumentation, safety systems and control are then recalled with reference to the principles to be adopted in order to achieve a high degree of reliability. The safety aspects of neutron flux control are compared for two types of light-water cooled reactors, i.e., the PWR and BWR. For these well proven reactors an attempt is also made to correlate the safety features deriving from thermal control, system stability and the aptitude to follow load changes as well as from their protection systems against equipment failure. Similar considerations are then applied to gas-cooled reactors of advanced designs such as the AGR and the Lucens type. (auth)

24751 STUDIES ON THE OPTIMIZATION OF CONTROL SYSTEMS FOR THE LUCENS NUCLEAR CENTER. Fishman, Y. (Therm-Atom SA, Lausanne, Switzerland). Neue Tech., 8: 19-26(1966). (In French).

In developing the control system of the Lucens nuclear

plant the following was taken into account: There are negligible natural feedbacks. The plant will be run either at constant power or according to demand. Security must be maintained in all possible cases. Both the system and its influence on security are described. Some results of analog studies as well as the basic assumptions are also given. (auth)

24752 UTILIZATION OF DIGITAL COMPUTERS FOR STARTING AND CONTROLLING THE EDF-3 POWER STATION. **Morin, R. (SREN, Paris). Neue Tech., 8: 26-32(1966). (In French).**

The complexity of the atomic power plant EDF3 led to the use of digital computers which have to collect centrally all the important data on the operating conditions of the plant. The main computer has to fulfil the following duties: processing of 2500 measurements, some values being recorded by choice, others when exceeding given limits; processing of 3000 signals regarding the working conditions of the plant; high-speed recording of about a hundred measured values and signals after a disturbance; leakage control of the canning; control of starting and shut-down operations; some controls and adaptations of prescribed values. In case of failing of the main computer, its most important functions are overtaken automatically by an auxiliary computer. Detailed investigations were made regarding the data reduction carried out by the computer with a view to simplifying as far as possible the interpretations to be performed by the operating staff. (auth)

24753 OPERATIONAL EXPERIENCE OF NUCLEAR POWER PLANT CONTROL SYSTEMS. **Flint, R. A. Neue Tech., 8: 33-46(1966).**

Operational experience of control systems in nuclear stations are considered from the view point of the designer and the design organization. In order to indicate the effects of operational experience on the original and subsequent designs, two major control systems are considered that are common to the Hinkley Point, Sizewell, and Wylfa nuclear power stations. The particular control systems for each station are outlined and compared with previous designs. Some of the problems that occurred prior to installation are highlighted, and for Hinkley Point and Sizewell some commissioning experience is given. Certain aspects of the design organization existing for the three stations are briefly described, together with some of the reasons for the changes that have taken place. (auth)

24754 CONDITIONS FOR ACHIEVING HIGH CONVERSION RATIOS IN THERMAL REACTORS (U–Pu CYCLE). **Zumbrunn, K. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Neue Tech., 7: 272-6(Dec. 1965). (In German).**

Essential quantities determining conversion ratio and breeding ratio in a thermal reactor are discussed in some detail. Knowledge of these quantities permits the definition of principles for constructing fuel elements having good conversion characteristics. (auth)

24755 THE PHYSICS PROGRAM OF THE URANIUM OXIDE-STEAM PROJECT. **Brogli, R. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Neue Tech., 7: 277-87(Dec. 1965). (In German).**

Optimization of the UoS plant is performed by four computer programs: one for the thermodynamic calculations, one for the physics calculations, a cost program, and the optimization program MINICH, which determines the minimum cost per kwh. MINICH searches a multidimensional surface for the lowest energy cost by calculating successive cost gradients until a minimum is reached. Some of the results from MINICH enter the thermodynamic analysis program which, in turn, feeds input to the physics program. In the physics program, PHYS, values for the four-factor formula, as well as D, L^2, and τ_f, are calculated using the methods of Soodak and Sullivan. Since these factors depend on burn-up and neutron flux, a burn-up subprogram (ABBRA) is included. Results from the various sections of the physics program, run both separately and together, were compared either with experimental data or with English and Swedish calculation methods. The overall agreement is satisfactory. (auth)

24756 INVESTIGATIONS ON FUEL UTILIZATION FOR VARIOUS ROD ROTATION SYSTEMS FOR THE URANIUM OXIDE-STEAM PROJECT. **Haschke, D. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Neue Tech., 7: 288-95(Dec. 1965). (In German).**

This report is a compilation of calculation methods used in the UoS project to investigate the long-term behavior of D_2O-moderated reactors. The simplifications which are made in order to obtain a fast calculation procedure on the computer are discussed. Different continuous and discontinuous refueling schemes are investigated for their suitability in this reactor concept. (auth)

24757 TRANSPORT OF IRRADIATED FUEL FROM LATINA TO WINDSCALE. **Kavanagh, M. T.; Gaultieri, G. Nucl. Eng., 11: 117-22(Feb. 1966).**

The transport of irradiated plutonium and uranium from Italy to Windscale for reprocessing is discussed. The irradiated fuel is transported in flasks filled with water as a heat transfer medium. Topics considered include contract and safety requirements, flask design and approval, technical considerations, transport arrangements, emergency procedures, indemnities and insurance provisions, and future development. (J.F.P.)

24758 THE INFLUENCE OF LOCAL ABSENCE OF COOLING ON THE CLADDING TEMPERATURE OF A FUEL ROD. **Kalker, C. M. (Reactor Centrum Nederland, The Hague). Nucl. Eng. Design, 3: 1-10(Jan. 1966).**

The temperature rise at the position of support of the fuel rods which results from the local absence of cooling is calculated. The support of the fuel rod is represented by a small circle, lying on the outer surface of the cladding, which simulates the contact area between fuel rod and supporting grid. The temperature rise is considered as a perturbation term superimposed on the undisturbed temperature distribution. Two extreme cases are considered, namely complete isolation of the perturbation term and complete cooling of the perturbation term outside the small circle. In order to compare with experimental results the same calculations are applied to a case of heat production in a steel tube, which is heated electrically. (auth)

24759 LOGICAL DESIGN OF POWER REACTOR PLANT LAYOUT. **Wearne, S. H. (Univ. of Manchester, Eng.); Hunt, J. A. Nucl. Eng. Design, 3: 83-94(Jan. 1966).**

Designing the layout of plant in a power reactor proceeds in parallel with theoretical analyses of performance and design of plant. Layout is the most practical side of design and is centered on the drawing office. Though it is a process of trial and change, there is a logic to the work. Very little analysis of this process was published, though the work is a substantial part of the engineering cost of a project. In the evolution of projects, the peak of layout work does not coincide with the peaks of analytical design and detailed plant design, yet analysis, layout and detail must finally be in agreement. An appreciation of each is needed in order to achieve this. The place and process of layout design, as experienced in development of two British nuclear generating projects in the series derived from the Calder Hall reactors are described. (auth)

24760 COMPILATION OF TRANSIENT TEMPERATURE DISTRIBUTION CURVES. **Steigelmann, William H. (Kuljian Corp., Philadelphia). Nucl. Eng. Design, 3: 186-91(Jan. 1966).**

Nondimensional temperature distributions curves are presented for the determination of the transient-temperature distribution in nuclear power plant components and structures. This method for transient-temperature-distribution determination is used for plotting transient temperature distribution if the thermal boundary conditions can be reasonably well approximated by those which apply in the cases considered. The initial temperature is uniform, internal-heat generation is negligible, and the temperature transient in the structure is induced by a change

in the temperature of the fluid which is on one or all sides of the structure. Three types of fluid-temperature variations are treated. (J.F.P.)

24761 LIQUID PLUTONIUM AS A FAST BREEDER FUEL. Hannum, W. H.; Peterson, R. E. (Los Alamos Scientific Lab., N. Mex.). Nucl. News, 9: No. 4, 21-4 (Apr. 1966). (LA-DC-7731).

A feasibility study of liquid plutonium as a potential fuel for fast breeder power reactors is presented. Features of the neutron economy of liquid plutonium systems are discussed. These are the low melting metallic alloys of plutonium not containing moderating components and the materials which contain the fuel in the reactor core. Thermal performance limits, safety features, and the lifetime of the fuel elements are summarized. Generalizations are made on the total economics of a power installation using liquid plutonium fuels. (B.G.D.)

24762 NUCLEAR POWER REACTOR AS AN ALTERNATIVE SOURCE OF ENERGY IN PAKISTAN. Hossain, Anwar. Nucl. Sci. Appl., 1: 1-12(Dec. 1965).

Arguments for the development of a nuclear power program in Pakistan in the near future are presented. These arguments are based on the increasing population and power consumption rates in a country in which conventional fuels are insufficient in quantity. A projected power development program for both West and East Pakistan is presented. (B.G.D.)

24763 THE ARDENNES NUCLEAR POWER PLANT. Hannothiaux, Andre (Electricite de France, Paris). Rev. Appl. Elec., 38: No. 210, 19-25(1965). (In French).

The nuclear power plant of Ardennes located in the town of Chooz is a joint enterprise between France and Belgium. The reasons for the selections of Ardennes for the location of the reactor and the experience to be gained in the construction and operation of the reactor are briefly summarized. The financial arrangements between France and Belgium are indicated. A brief description is given of the enriched uranium PWR reactor to be constructed and designed for startup in 1966. (J.S.R.)

24764 PREVENTION OF COMBUSTION AND EXPLOSION IN NUCLEAR POWER PLANTS WITH ORGANIC-COOLED REACTORS. Basso, Guiseppe. Riv. Ing. Nucl., 3: 815-20(May-Aug. 1965). (In Italian).

The characteristics of non-irradiated coolants and the standards for their use and storage are outlined. The effects of radiation on flammability characteristics are discussed. The precautions to be taken to prevent combustion and explosion of the organic liquid coolants are outlined. (J.S.R.)

24765 THERMODYNAMIC CYCLES OF NUCLEAR POWER STATIONS. Kalafati, D. D. New York, Daniel Davey and Co., Inc., 1965. 207p. $14.00. Israel Program for Scientific Translations, Jerusalem, 1965.

Translated from Termodinamicheskie Tsikly Atomnykh Elektrostantsii by Z. Lerman.

The theory of thermodynamic cycles in nuclear power stations and some results achieved in specific power stations are discussed. Consideration is given to operating conditions, optimum thermodynamic cycles in power stations with variable thermal power, effect of reactor temperature characteristics on optimum cycle parameters, thermodynamics of heat transfer in steam generators and condensers, regenerative water heating, and optimum power consumption for coolant recycling. Thermodynamic cycles of nuclear power stations with reactors cooled by water or steam, organic liquids, liquid metals, and gases are studied. (M.J.T.)

24766 SOME CALCULATIONS OF FAST REACTOR DOPPLER AND SODIUM LOSS COEFFICIENTS WITH PARTICULAR REFERENCE TO THE EFFECTS OF CORE LATTICE STRUCTURE AND RADIAL FUEL TEMPERATURE DISTRIBUTION. Codd, J.; Durston, C.; Wright, W. (Atomic Energy Establishment, Winfrith, Eng.). 12p. (CONF-651009-13). ORAU. Gmelin, AED-CONF-65-307-13.

From Conference on Safety, Fuels, and Core Design in Large Fast Power Reactors, Argonne, Ill.

The results of calculations on the effects of core heterogeneity in the main Doppler region of the spectrum and the treatment of resonance capture in a fuel rod with a radial temperature distribution are given. It was found that the reactivity of a typical dilute fast power reactor and the Doppler and sodium loss coefficients are only slightly influenced by heterogeneity effects in the resonance energy region below 15 kev. (J.F.P.)

24767 IMPROVEMENTS IN OR RELATING TO NUCLEAR POWER STATION REACTORS. Stille, Carl-Erik. British Patent 1,022,003. Mar. 9, 1966. Filed Nov. 7, 1963.

A nuclear power station reactor includes a concrete pressure vessel that is rectangular or substantially rectangular so that adjacent vertical side walls meet at right-angled or substantially right-angled vertical corners. The vessel contains a centrally located moderator structure and four steam-rising units, each lying between the moderator structure and a different one of the four vertical corners of the pressure vessel. A continuous flow path is provided for the circulation of gas through the moderator structure; and one of the steam-rising units comprises four vertical limbs, two for the upward circulation of gas and two for its downward circulation. The gas-circulating means is a vaned impeller driven by a steam turbine. (B.L.M.)

24768 NUCLEAR REACTORS HAVING PRESSURE TUBES. (to Sulzer Brothers Ltd.). British Patent 1,022,158. Mar. 9, 1966. Priority date Jan. 28, 1964, Switzerland.

A pressure tube design for the moderator section of a reactor core is patented in which a coolant inlet flow passage devoid of fissile material leads from one end or two passages lead from each end of the pressure tube to the mid-portion of the pressure tube and coolant outlet flow passages containing fissile material lead from the mid-portion to both ends of the pressure tubes. Guide means are included in the pressure tube, which cooperate with the tube to bound flow passages for guiding the coolant. A number of different pressure tubes embodying the invention are described in detail. (B.L.M.)

24769 IMPROVEMENTS IN MAGNETOPLASMADYNAMIC ELECTRIC GENERATORS. Woodcock, Melville Thomas; Wharmby, John Stephen (to Babcock and Wilcox Ltd.). British Patent 1,022,246. Mar. 9, 1966. Filed Dec. 21, 1962.

A magnetoplasmadynamic electric generator patented for operation with a nuclear reactor is adapted to operate with a flow of ionized medium in a closed circuit. In this closed circuit is circulated a gas/solid suspension that is heated in the nuclear reactor core. Particles within the suspension are radioactively contaminated with volatile fission products from the reactor fuel. The suspension is supplied in the ionized state to the generator. (B.L.M.)

24770 NUCLEAR REACTOR HAVING A VAPORIZABLE COOLANT. Jones, Jack; Challender, Ronald Scott (to United Kingdom Atomic Energy Authority). British Patent 1,022,354. Mar. 9, 1966. Filed July 16, 1962.

In the design of a reactor using a vaporizable liquid as both coolant and moderator, such as a boiling water reactor, better control of the coolant results in less distortion of the neutron flux, so that the power output is increased and the stability of the reactor improved. The vaporizable coolant is contained within a pressure vessel having two flow paths in series for the coolant through the core of the reactor in opposite directions. Nuclear fuel is situated in the second flow path which is upwardly from the lower region to a second upper region. Heat transfer occurs simultaneously from the fuel to the liquid in the second flow path and from the liquid in the second flow path to the liquid in the first flow path. Regulating means are provided so that in operation, the temperature of liquid at entry to the second flow path is just below its saturation temperature, and liquid having transversed the second flow path is discharged in the boiling condition to the upper region. (B.L.M.)

24771 STEAM GENERATION IN NUCLEAR REACTORS. (to Allmaenna Svenska Elektriska Aktiebolaget).

British Patent 1,023,094. Mar. 16, 1966. Priority date Dec. 28, 1961, Sweden.

A method is patented for converting a coolant into steam in a nuclear reactor with a tubular fuel assembly. The coolant first flows along the outside of a fuel assembly and is warmed up to or almost to its boiling point. Then the coolant flows in the opposite direction through the interior of the fuel assembly. Inclined guide surfaces or the like cause the coolant to rotate rapidly after it has passed along the outside of the fuel assembly. A tubular member surrounds the fuel element assembly with a large clearance to provide a flow duct for the coolant. The inclined guide surfaces are provided in the flow duct at the end of the fuel assembly. This rotation of the coolant produces a certain pressure drop after which the coolant enters a funnel-shaped surface up which the liquid coolant flows due to centrifugal force. The pressure drop causes increased boiling in the inclined contact surface between liquid and the vaporized coolant. The inner surface of the fuel assembly is provided with inclined guiding flanges in a variety of forms, such as separate short guiding blades or continuous helical guiding surfaces. At least one collecting space for superheated steam is provided beneath the fuel assembly. (B.L.M.)

24772 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Webb, John; Friar, Harold; Pounder, John Ormerod (to United Kingdom Atomic Energy Authority). British Patent 1,023,584. Mar. 23, 1966. Filed July 3, 1961.

A nuclear reactor includes a core substantially submerged in a liquid coolant mass with a pressurized blanket gas above the coolant. A free surface exists between the coolant and the blanket gas. A core service tube extends into the coolant mass from above its free surface. This tube provides withdrawal and insertion of fuel elements into the core while the element is surrounded by coolant liquid. This service tube is open at its lower end and sealed in a gas-tight manner at the upper end so as to trap gas by means of which the coolant surface within the service tube is controlled. The service tube is movable to vary the extent of immersion of the lower open end in the coolant. (B.L.M.)

24773 CONTROL SYSTEM FOR A STEAM GENERATOR RECEIVING HEAT FROM A NUCLEAR REACTOR. Weber, Max (to Sulzer Brothers Ltd.). U. S. Patent 3,240,675. Mar. 15, 1966. Priority date Sept. 12, 1962, Switzerland.

A system is provided for regulating the supply of a liquid operating medium to a vapor generator having a superheater and forming part of a nuclear reactor plant in which a heat carrying fluid circulates through the reactor for cooling it and through the vapor generator for heating it. A temperature sensing device is connected to an intermediate portion of the superheater of the vapor or steam generator. This device produces a control signal that is used for controlling the actuation of means for regulating the supply of liquid operating medium or feedwater to the generator. By this system, the outlet temperature of the operating medium of the vapor generator is accurately maintained. (B.L.M.)

24774 NUCLEAR POWER PLANT SYSTEM. Sanders, Donald G.; Zmola, Paul C. (to Combustion Engineering, Inc.). U. S. Patent 3,242,053. Mar. 22, 1966. Filed Dec. 8, 1960.

A nuclear power plant includes a reactor that is cooled and moderated by hydrogenous fluid, preferably light water. The reactor is operated so that it is self-pressurized with a portion of the power developed by the reactor being used for the production of vapor. Moderator-coolant in a liquid state and at saturation temperature is passed through a steam generator, which is in the form of an indirect heat exchanger, and then in a subcooled condition back to the reactor for passage up through the core. This forms the primary loop of the circulation system. In the steam generator steam is developed in the secondary loop. This steam is conducted to a superheater, which is also an indirect heat exchanger and which receives as its heating medium vapor from the reactor. This vapor is condensed upon being passed through the superheater with the heat of condensation being imparted to the secondary steam which passes through this superheater. This preheated secondary steam is delivered to the high pressure end of the turbine. The pressure of the superheated steam delivered to the turbine is maintained constant by means of a control device responsive to this pressure. This assures that the steam conditions in the turbine will remain generally constant. The cycle of the power plant may or may not employ a reheater. (B.L.M.)

Process Heat Reactors

Refer also to abstract 24738.

24775 (ORNL-P-2071) AGRICULTURAL WATER BY NUCLEAR DESALINATION AND TECHNICAL ROUTES TO ITS ACHIEVEMENT. Hammond, R. Philip (Oak Ridge National Lab., Tenn.). Mar. 14, 1966. Contract W-7405-eng-26. 25p. (CONF-660311-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Symposium on Water Production Using Nuclear Energy, Tucson, Ariz.

The nature of technical achievements that are missing in the production of agriculture water by nuclear desalination are defined, and their difficulties are outlined. The urgency of the program is discussed. (P.C.H.)

24776 NUCLEAR ENERGY—POTENTIAL FOR DESALTING. Ramay, James T. (U. S. Atomic Energy Commission, Washington, D. C.). Nucl. Energy, 60-6 (Mar. 1966).

The development of nuclear energy for sea water desalting is discussed. Topics considered include nuclear and fossil energy resources, the advantages of nuclear energy, trends in nuclear plant and operating costs, the history of desalting using nuclear power, and the AEC program for desalting application. Also discussed are engineering studies of desalting installations, scale-up of the desalting technology, and the international program. The goals of this development are to provide a nearly inexhaustible resource of energy, and large quantities of pure water from the sea at reasonable cost. (J.F.P.)

Production Reactors

24777 (DPSPU-66-30-6) REACTOR ON-LINE COMPUTER. Wilmer, W. B.; Bickley, J. D.; Studley, R. V.; Taylor, W. M.; Thompson, J. J. (Du Pont de Nemours (E. I.) and Co. Savannah River Plant). Mar. 1966. Contract AT(07-1)-1. 27p. (CONF-660408-3). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Instrument Society of America, Southeastern Conference and Exhibit, Augusta, Ga.

A prototype system that is used to improve the operating safety and efficiency of a large production reactor at the Savannah River Plant is described. The on-line computer receives information from about 3300 sensors that monitor the reactor and cooling systems and provides the reactor operators with data for adjusting the axial and radial power distributions. (D.C.W.)

Propulsion and Space

See also ENGINEERING — Space Propulsion

Refer also to abstract 23796.

24778 (IDO-17148) TRANSDUCER DEVICE EVALUATION USING HIGH EXPLOSIVES. Meservey, R. H. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 1966. Contract AT(10-1)-205. 53p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

A description is presented of the performance of various transducer devices as they were subjected to the transient forces produced by chemical explosives. Devices were tested for use in measuring dynamic overpressures and

shock wave propagation velocities. Reactor disassembly detecting instrumentation in the form of accelerometers, linear displacement transducers, strain gages, event recording devices, optical trackers, and thermocouples were also tested. Dispersed fuel temperature measuring techniques were investigated by means of thermocouples and an optical pyrometer. The series of tests was conducted on behalf of the STEP program to determine appropriate instrumentation and instrumentation techniques for the SNAPTRAN-2 destructive test. (auth)

24779 (IDO-17161) GAMMA ENERGY RELEASE FROM FISSION PRODUCT DECAY FOLLOWING A SHORT REACTOR TRANSIENT. Warkentin, J. K. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 1966. Contract AT(10-1)-205. 32p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The results of an investigation to determine the rate of gamma ray energy release from fission product decay following a short power transient are presented. The investigation involved several experiments in which the energy release rate as a function of time from 1 to 10^4 seconds after fission was obtained by measuring the decay gamma dose rate near the essentially unshielded SNAPTRAN-1 reactor following a transient of less than 300 milliseconds duration. The results obtained are compared with both experimental and theoretically computed data found in the literature. For decay times less than 200 seconds, the results are in good agreement with the referenced experimental data but are considerably higher than the computed data. For longer decay times, agreement is good with all the referenced data. (auth)

24780 (LA-DC-6751) COMPUTING METHODS FOR ROVER REACTORS. Mills, C. B. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 59p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The numerical approximations to the diffusion and transport equations for neutron flux in a reactor are written as intervals in space and angle for each set of connected energy intervals. The conventional transport forms are also reviewed for anisotropic scattering cross sections and resonance integrals. Reducing an actual reactor experiment to a mathematically computable form requires the combination of theoretical and experimental approximations in ways specific to the experimental assembly. This procedure involves three steps: (1) homogenization and symmetrization of the geometrically coarse-grained assemblies, with changes in neutron cross section to effective values where appropriate; (2) weighting of moderator volume and reactor dimensions for equivalent neutron transport and slowing down; and (3) comparison of a systematic and simple experimental display to evaluate errors. The computing system was applied to a high-power reactor experiment and proved to be entirely adequate in the area interest. Measurements of fission density as a function of space at high temperature corresponded well with the expected distribution. (M.O.W.)

24781 (N-65-11146) REACTIVITY CHANGES DURING STARTUP IN LARGE NUCLEAR ROCKETS [Thesis]. Little, Winston W. Jr. (Massachusetts Inst. of Tech., Cambridge). Aug. 1964. 161p. (NASA-CR-59533; MITNE-52). CFSTI $5.00 cy, $1.00 mn.

The material properties, such as core temperature, hydrogen density, etc., were computed as a function of time during startup for a specified power and flow-rate buildup. Using these time-dependent properties, the reactivity variations during startup were calculated using a diffusion theory model with 55 energy groups. The spatial dimensions were approximated by assuming $\nabla^2\phi(E) = -B^2\phi(E)$. It was found that large thermal nuclear rocket reactors (C/U = 2500) are much more sensitive to changes in hydrogen density and core temperature than small nuclear rockets (C/U = 250). The large reactivity coefficients present in thermal reactors cause both large (~ −$13) and rapid (~ −$1/sec) reactivity variations during the quick startups contemplated for nuclear rockets. This problem can be ameliorated to some degree by adding a nuclear poison to the core. However, any poison has the adverse side effect of decreasing the worth of an external control rod system by decreasing the leakage. An estimation of the worth of an external control rod system was obtained using a one-dimensional nucleonics model with three energy groups. (auth)

24782 (NAA-SR-11502) THERMAL BEHAVIOR OF SNAP REACTOR FUEL ELEMENTS DURING ATMOSPHERIC REENTRY. Barsell, A. W.; Montgomery, L. D.; Arnold, J. E. (Atomics International, Canoga Park, Calif.). Mar. 25, 1966. Contract AT(11-1)-Gen-8. 122p. Dep. mn. CFSTI $4.00 cy, $1.00 mn.

Trajectory transient calculations are made for SNAP-10A reactor fuel elements released from the reactor vehicle at selected altitudes between 200,000 and 400,000 ft. The aerodynamic heating, transpiration cooling, and the chemical reactions of the fuel with air are analyzed to determine the net surface heat flux to the elements. An analytical model is described with which simultaneous solutions of the heat and hydrogen transport equations are obtained including variable material properties and material phase changes. A detailed evaluation of available information concerning fuel material properties is given. Using the best available data, minimum fuel element ejection altitudes are estimated from which complete ablation of the fuel can be achieved. The computations are performed for fuel element trajectories with cross-axial-spinning, end-over-end-tumbling, and random-tumbling flight orientations. A statistical analysis of the computations is presented, from which probabilities of initial fuel ablation are derived as a function of release altitude. The statistical procedure is concluded to be a valid and optimum method of analysis. Data from experimental tests on the transient heating and burnup of the fuel material in a hyperthermal wind tunnel are used to correlate the analytical description. The agreement is found to be good and within deviation due to uncertainties in parameters. (auth)

24783 BASIC DESIGN ON THE FIRST NUCLEAR-POWERED SHIP. Udagawa, Sadao (Japan Nuclear Powered Ship Development Agency). Kaiun, 38: 41-55 (Mar. 1965). (In Japanese).

The basic design of the hull, the engines, the electric power supply, and the nuclear reactor for the first Japanese nuclear-powered ship is outlined. The primary purpose of the ship is to gain experience in building and navigation; the ship will be used for oceanographic surveying. A dual-cycle light-water reactor is used for the power plant with emphasis on nuclear safety. The nuclear fuel is slightly enriched UO_2 pellets with stainless steel cladding. The ship is of the long-forecastle type with a total tonnage of 6900 tons and a maximum speed at full load of 17.8 knots. (TCO)

24784 APPROXIMATE ANALYSIS OF THE KIWI TNT EXPERIMENTS. Koehler, W. H. (Texas Agricultural and Mechanical Univ., College Station). Raumfahrtforschung, 10: 14-19(Jan.-Mar. 1966). (In German).

Several experimental results of the KIWI excursion test are compared to numerical solutions for a point reactor model and to the analytical solution of the Fuchs model. (auth)

Research and Test Reactors

Refer also to abstracts 22856, 23238, 23241, and 24734.

24785 (AEET-237) CIR LOOP: A PROGRAM TO CALCULATE THE REACTIVITY LOAD AND RELATIVE POWER OUTPUT OF A LOOP IN CIR. Srinivasan, K. R.; Suryanarayanan, P. V. (Atomic Energy Establishment, Trombay (India)). 1965. 26p. Dep. mn.

Details of the program CIRLOOP which was written in FORTRAN language for CDC-3600 are given. The program calculates the reactivity load and power output of a loop in CIR at the central position. (auth)

24786 (ANL-7176, pp 73-85) ADVANCED SYSTEMS RESEARCH AND DEVELOPMENT. (Argonne National Lab., Ill.).

Reactivity worth calculations were made for Hf control blades with Al followers in the AARR. The reactor physics characteristics of the Internal Thermal Column were investigated. Summaries of research on the following aspects of AARR development are presented: core structure fuel and materials development, reactor vessel, and experimental facilities. (M.O.W.)

24787 (BNWL-SA-577) PLUTONIUM RECYCLE TEST REACTOR EXPERIENCE, 1962-1966. Purcell, R. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 15, 1966. Contract AT(45-1)-1830. 40p. (CONF-660516-1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Annual Conference on Organic and Heavy Water Reactors, Winnipeg, Canada.

A brief description of the reactor is given. Detailed descriptions are given concerning the operating history of the various components of the PRTR. (M.O.W.)

24788 (CEA-R-2889) MESURES DU COEFFICIENT DE DIFFUSION RADIAL DANS AQUILON II PAR L'ETUDE DE LA DISTORSION DE LA STRUCTURE FINE. (Measurement of the Radial Diffusion Constant at Aquilon II by Means of the Study of the Distortion of the Fine Structure). Gaunet, Philippe; Mazarakis, Michel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1965. 32p. Dep. mn.

Measurements are presented of the radial diffusion constant of thermal neutrons by means of the study of the interaction of macroscopic flux and of fine structure in Aquilon II. The use of two types of clusters allows comparison of the effect of the fuel distribution on the radial diffusion constant. Two types of measurement were used: macroscopic or "amont-aval" method in which the perturbation brought by the microscopic flux on the macroscopic flux is measured; and microscopic or "fine structure" method, which analyzes the distortion of the fine structure of a cell under the effect of the macroscopic flux. (auth)

24789 (EUR-2714.e) A MEASUREMENT OF THE HYPERFINE STRUCTURE OF THE THERMAL FLUX DISTRIBUTION IN THE UC CLUSTERED FUEL ELEMENT ESSOR C-2-φ. Guardini, S.; Pipitone, G. F. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1966. 44p. Dep. mn.

The detailed hyperfine structure distribution of the thermal flux in the clustered fuel element of the first charge of the ESSOR reactor was measured by activation of Dy detectors. This element consists of a cluster of 4 uranium carbide rods, organic cooled, which is moderated by D_2O. Several degrees of poisoning of the element (corresponding to the increasing burnup) were investigated. The measured flux distributions were compared with the corresponding distributions obtained by an analytical expression of empirical nature. (auth)

24790 (IDO-17158) CRACK IN THE ENGINEERING TEST REACTOR PRIMARY COOLING SYSTEM. Smith, E. H.; Liebenthal, J. L.; Killian, H. D.; Hoopingarner, K. R.; Moen, R. A. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Mar. 1966. Contract AT(10-1)-205. 50p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

On August 28, 1965, primary water leakage was found coming from a crack in the 36 inch ETR reactor outlet line. The pipe was repaired by cutting from the pipe wall a rectangular piece containing the crack and welding in a new piece of the same material and dimensions. A large reinforcing plate was welded over this repair. Metallurgical tests showed that the failure was a fatigue crack originating at the edge of a weld joining a coupling to the pipe wall. Although the failure apparently resulted from a unique combination of circumstances, vibration of a sample probe installed through the coupling was believed to be a major contributor. Dye penetrant examinations, ultrasonic flaw detection tests, and strain gauge measurements showed that the repair was sound and that no other potential failure areas existed in the piping system. (auth)

24791 (IKF-16) ARBEITSBERICHT DER NEUTRONENBEUGUNGSGRUPPE DARMSTADT-FRANKFURT/M. (Report of the Neutron-Diffraction Group, Darmstadt-Frankfurt/M). (Institut fuer Kernphysik, Universitaet Frankfurt (West Germany)). Feb. 1966. 39p. Dep. mn.

The neutron diffractometers at the research reactor FR-Frankfurt/M. and FR2-Karlsruhe are described. The following investigations are reported briefly: slow neutron detectors for diffractometers, a high sensitive neutron-camera, Debye-Waller factor of diamond and silicon, distribution of cations in Mn-Zn-ferrite. (auth)

24792 (MITNE-62) TECHNICAL SPECIFICATIONS FOR THE MIT RESEARCH REACTOR. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Aug. 16, 1965. 110p.

The prevention of a reactor accident can be assured by carefully controlling a number of independent or semi-independent parameters. The technical specifications of these parameters are described. (M.O.W.)

24793 (RT-FI-(65)-53) MISURA DELLA VITA MEDIA DEI NEUTRONI PRONTI NEL R.O.S.P.O. TRAMITE METODI STATISTICI. (Measurement of Prompt Neutron Lifetime in the R.O.S.P.O. Using Statistical Methods). Pacilio, N.; Ferrari, T. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Dec. 1965. 37p. Dep. mn.

An experimental analysis of the distribution of neutrons from a detector placed in a critical configuration of the R.O.S.P.O. reactor was made. The analysis, performed by three consistent methods, yields to measure the prompt neutron lifetime and the absolute power level. It was shown that, within a wide range, the negative binomial and the experimental counting distribution coincide. (auth)

24794 RESEARCH CENTERS IN EUROPE. No. 15. ROSSENDORF UEBER DRESDEN. EuroNuclear, 3: 143-50(Mar. 1966).

A status report on the organization, experimental facilities, and the research programs of the nuclear research institute at Rossendorf ueber Dresden is presented. (B.G.D.)

24795 INCREASING THE POWER OF THE ROSSENDORF RESEARCH REACTOR WWR-S FROM 2 TO 5 Mw. Adam, E. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 9: 1-4(Jan. 1966). (In German).

The problems of increasing the power of the Rossendorf Research Reactor RFR from 2 up to 5 Mw by using roughened fuel elements are considered. Starting from a discussion of the heat transfer, the technological problems of roughening and testing the fuel elements are described. The measurements during the start-up of the new core show that variation of the critical mass does not take place as a consequence of roughening and that a power of 5 Mw may be produced without hazard with respect to surface boiling. Finally, some measures of reconstruction joint with increasing power are discussed. (auth)

24796 PRELIMINARY HEAT-TRANSFER AND HYDRAULIC STUDIES FOR INCREASING THE POWER OF THE ROSSENDORF RESEARCH REACTOR WWR-S. Schwarz, K. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 9: 5-8(Jan 1966). (In German).

The preliminary heat-transfer studies served as a means for determining the conditions which allow doubling of the thermal power of the reactor without the necessity of changing the upper and lower temperature limits. The increased power is removable by the heat exchangers and the cooling tower already existing when the heat transfer coefficient of the fuel elements is increased for a factor more than 2. This last requirement was fulfilled by roughening the surfaces of the fuel elements. (auth)

24797 TEMPERATURE MEASUREMENTS ON SMOOTH AND ROUGHENED FUEL RODS OF THE ROSSENDORF RESEARCH REACTOR. Kische, R.; Adam, E. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 9: 8-12(Jan. 1966). (In German).

The temperature of the fuel cannings with smooth or

roughened surface was measured in a 5 Mw operation regime of the reactor WWR-S. It is shown for a flow rate of the water coolant in the primary circuit of 930 m^3/h that heat transfer from the fuel rod to the water coolant may be improved for 2.35 times by roughening the surface of the rod. The variation of temperature in the fuel canning as a function of the position of the control rod amounts to max. (27 ± 4)°C for the smooth fuel rod and to max. (12 ± 2)°C for the roughened one. This corresponds to local variations of both the neutron flux density and the temperature difference between canning and water coolant of max. (39 ± 4)%. Knowing the temperatures of the surfaces of the fuel rods permits the increase of the power of the Rossendorf Research Reactor and optimization of the plant operation. (auth)

24798 EMERGENCY COOLING SYSTEM OF THE ROSSENDORF RESEARCH REACTOR (RFR). Klebau, J. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 9: 14-16(Jan. 1966). (In German).

The decreases of neutron density and of radiation power of the fission products after shutdown of the reactor were calculated, and on these bases the principal properties of the emergency cooling system of a water-cooled tank-type reactor as well as the problems of the technological layout of the plant were determined. Finally, the emergency cooling system necessary for the Rossendorf Research Reactor as a consequence of the planned increase of nominal power and optimal design is discussed. (auth)

24799 WATER TREATMENT PLANTS OF THE ROSSENDORF RESEARCH REACTOR WWR-S. Westphal, D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 9: 17-20(Jan. 1966). (In German).

A survey of the recent state of the water treatment plants of the Rossendorf Research Reactor WWR-S is given. The technique of ion exchange has shown to be more economical than distillation for treating the feed waters. The ion exchangers used were produced by VEB Farbenfabrik Wolfen. They have proved to be very suitable for use in nuclear reactors. (auth)

24800 FISSION GAS DIFFUSION LOOP AT JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. Yajima, Seishi (Tohoku Univ., Japan); Kamemoto, Yuichiro; Shiba, Koreyuki; Handa, Muneo. Nippon Genshiryoku Gakkaishi, 8: 3-11(1966). (In Japanese).

An in-pile loop is described which is capable of continuously measuring the release of fission gas from ceramic fuels during irradiation in the JRR-3. The fuel specimen is heated to temperatures of up to 1,000°C by the combined action of its own fission and a Pt wire heater. The neutron flux for the specimens is controlled by changing the rod pattern and the reactor power. Specimens of about 22-mm diameter and of lengths up to 40 mm can be accommodated. A continuously flowing sweep gas (He gas) carries the fission gases outside the reactor where the radioactive isotopes are measured by γ-ray spectrometry. The nonradioactive gases released from the specimen during irradiation are determined continuously by an elusion gas chromatograph. (auth)

24801 ANALYSIS OF PHOTONEUTRON FLUX DISTRIBUTION IN WATER-SHIELDED REACTORS. Tagami, Takashi; Kitazume, Mitsuyuki (Hitachi Ltd., Tokyo). Nippon Genshiryoku Gakkaishi, 8: 12-15(1966). (In Japanese).

In a water-shielded reactor, the photonuclear reaction D(γ,p)n takes place between γ rays emitted from reactor core and deuterons contained in the shielding water surrounding the core. Photoneutrons produced by the reaction are distributed in the water layer in addition to the neutrons originated from the core. It is shown that the distribution of the thermal photoneutron flux ϕ_t^γ in water not close to the core surface is approximately given by the simple formula:

$$\phi_t^\gamma = \Sigma_i \frac{\Sigma_{\gamma n}^i/\Sigma_2}{(1-\mu_i^2\tau)(1-\mu_i^2 L^2)} \varphi_\gamma^i, \quad (L^2 = D_2/\Sigma_2)$$

where φ_γ^i and μ_i represent the γ-ray flux in the i-th energy group and its linear absorption coefficient in water, $\Sigma_{\gamma n}^i$ is the macroscopic cross section for the photoreaction, D_2 and Σ_2 are the diffusion coefficient and the absorption cross section for thermal neutrons in water and $\sqrt{\tau}$ is the slowing-down length in water. Comparison of the calculated results to the experiments in BSR-1 shows that the above formula reproduces the photoneutron distribution reasonably well in a region where the neutron flux originated from the reactor core is negligibly small. In particular the above expression for photoneutrons together with the calculated neutron flux originated from the core can explain a bend in the observed neutron flux distribution occurring at about 1.8 m from the core surface of BSR-1. (auth)

24802 CONSTRUCTION OF THE MULTIPURPOSE RESEARCH CENTER AT THE NUCLEAR RESEARCH CENTER KARLSRUHE. Klee, Oskar (Siemens-Bauunion GmbH, Mannheim, Ger.). Nucl. Eng. Design, 3: 95-104 (Jan. 1966). (In German).

Description of design and construction of the reactor building, the fuel element storage building and diverse accessory buildings of the multipurpose research reactor facility MZFR at the nuclear research center Karlsruhe are described. (auth)

24803 ANALOGICAL STUDY OF THE XENON AND SAMARIUM POISONING IN THE 2 MW VVR-S NUCLEAR REACTOR OF THE INSTITUTE FOR ATOMIC PHYSICS OF BUCHAREST. Haraga, C. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 10: 799-821(1965). (In French).

A study was made to determine the growth of the concentration of xenon and samarium in the VVR-S Reactor at the Institute for Atomic Physics in Bucharest. It is concluded that poisoning by xenon has an appreciable effect only for a flux greater than 10^{13}. This effect is more important if the flux falls instantaneously to zero rather than to $1/100$ of its value. The same conclusions are drawn for samarium. The curves obtained are shown. (J.F.P.)

24804 SOME METHODS FOR THE RADIOISOTOPE IDENTIFICATION IN REACTOR COOLING CIRCUITS. Filip, A.; Ionescu, Elena; Alexan, Zamphira (Institut de Physique Atomique, Bucharest). Rev. Roum. Phys., 10: 829-37(1965). (In Russian).

A description of the methods used for the identification of radioisotopes in the coolant in reactors of the type VVR-S at the Institute of Atomic Physics in Bucharest is presented. Radiometric methods used are the determination of beta-ray energy by absorption in aluminum, the gamma-ray energy determination by scintillation spectrometry, and the half life of radioactive elements. A radiochemical method used is ion-exchange separation. The results obtained during the period from 1961 to 1964 by the application of these methods to purity control for the water in the primary circuit of the VVR-S Reactor are shown. (tr-auth)

24805 MATERIALS TESTING REACTOR, USING A LIGHT- AND HEAVY-WATER MIXED MODERATOR. Komai, Kenichiro (to Hitachi, Ltd.). Japanese Patent 1964-6154. Mar. 27, 1965. Filed Sept. 12, 1962.

An improved materials testing reactor is proposed in which the gamma heating is reduced and the stiffness improved. For this purpose, a mixture of light and heavy water is used as the moderator. By utilizing the large difference in absorption cross sections between light and heavy water, and changing the mixing ratio suitably, the operating conditions of the reactor can be altered. A mixing ratio corresponding to the desired operating conditions, is selected in the range 20 to 40 volume percent of light water. During the reactor operation, this mixing ratio is maintained constant. (TCO)

24806 REACTOR CORE FOR SWIMMING POOL TYPE REACTORS. Komai, Kenichiro (to Hitachi, Ltd.). Japanese Patent 1964-6156. Mar. 27, 1965. Filed Feb. 16, 1962.

A reactor core is designed to minimize the gamma radiation due to the recoil atoms at the pool surface when the power output is increased. Walls surrounding the reactor core extend above the core, and on the upper part of these walls a primary coolant header is installed circumferen-

tially; this header has a number of openings through the walls to introduce the coolant into the reactor core. A lid for the core container is installed, with the circumferential header as the supporting base; various vertical members such as control rods penetrate through this lid into the reactor core. The lid can be raised or lowered by means of screws installed at the ends of the lid. Below the reactor core is installed a water chamber, receiving the primary coolant through the reactor core; the heated coolant flows out from this chamber. (TCO)

24807 COOLING DEVICE FOR SWIMMING POOL TYPE REACTORS. Iwashita, Fumio (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-6160. Mar. 27, 1965. Filed Sept. 26, 1962.

The device proposed permits change from forced circulation to the natural convection, or vice versa, by suitable operation of a pump installed in the passage of the forced-circulation coolant water. The pump circulates the coolant through the reactor core, a coolant chamber connected to the bottom of the reactor core, and the heat exchanger, and into the top of the reactor core. Through the wall of the coolant chamber are made a number of holes for introducing the natural-convection coolant water into the reactor core. During forced circulation the leakage through the small holes is negligible. (TCO)

24808 FLUX-TRAP RESEARCH AND TESTING NUCLEAR REACTOR. Leyse, Carl F.; Elgert, Oscar J.; Leonard, Byron H. Jr. (to Internuclear Co.). U. S. Patent 3,238,107. Mar. 1, 1966. Filed Apr. 3, 1963.

A flux-trap research and testing reactor includes an annular pressurized vessel positioned within the main vessel and a core containing material fissionable by thermal neutrons positioned within the annular pressure vessel. The reflector assembly is positioned about the pressurized vessel and includes at least one droppable fluid reflector material and a solid reflector material. The reactor control means includes at least a fluid control material and is located between the pressurized annular vessel and the reflector assembly. Coolant is passed through the main vessel, and pressurized coolant is passed through the annular pressurized vessel, so that the reactor controls and reflector assembly are non-pressurized while the core is pressurized. Preferably, the fluid control means comprises a relatively thin region of borated water substantially adjacent to the core. The core is positioned about a non-pressurized light water island opening into the main vessel. This island facilitates the insertion of experimental facilities without the problem of pressure sealing, and the split top head of the core permits refuelling without removal of experimental facilities or test loops. (B.L.M.)

WASTE DISPOSAL AND PROCESSING

See also BIOLOGY AND MEDICINE — Ecology
CHEMISTRY — Radiochemistry
CHEMISTRY — Separation Processes and Procedures
HEALTH AND SAFETY

Refer also to abstracts 23252 and 23408.

24809 (BNWL–213) RESEARCH AND DEVELOPMENT ACTIVITIES, FIXATION OF RADIOACTIVE RESIDUES. Quarterly Progress Report, October–December 1965. Platt, A. M. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1966. Contract AT(45-1)-1830. 38p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Intensive study of one composition melted under various conditions indicated a marked change in properties (solubility and drip temperature) as the processing temperature was raised. At a given temperature, holding periods between 1 and 4 hr have little effect. There appears to be an optimum processing temperature. Thermal expansion of the candidate solids for WSEP was measured and found to be in a range that would be compatible with stainless steel containers. Slope of the temperature reciprocal versus log solubility line in the range 75 to 95°C was found to be −4.68. It was found that at high fission product levels rare earth phosphates crystallize out in the melter. A series of 46 melts was prepared for a statistical study of the effects of additives to PW-2 waste on melt and product properties. None of the specific compositions tried had the desired properties of a high sulfate retention and a stickpoint above 700°C. It was found that nickel, Corronel 230, and Hastelloy G have inadequate corrosion resistance for use as melter construction material. The separation efficiency and performance of wire-wound filters showed that they could be used for the spray calciner. The scope of the WSEP GE-412 computer program was defined and an operating procedures guide for using the computer was written. Design verification tests on the spray calciner were completed by filling an 8-in.-dia container 8 ft long with glass. Retention of sulfate was necessary for good performance of the spray calciner. Containers were filled without stalagmite formation when the wall temperature of the container was within 100°C of the melting point. Expressions were derived for the change of recycle stream compositions with time for WSEP. The cases of continuous and batch recycle were considered. Fission product release studies involving simulated high level ceramic wastes were extended to include different ceramic compositions. Both phosphate and fission product contents were varied. In most instances, release rates at 1100°C for ^{137}Cs were found to range from 0.2 to 0.5%; however, some exceptions were observed. Attempts to measure an entrainment rate for particles (cesium is volatilized into the airstream) resulted in releases below the detection limit of the equipment — less than 10^{-5} released. Studies were concluded on sulfate melts prepared from simulated glass melter condensates. Some types of lead sulfate melts could be prepared and used as storage media, however, the long processing times required makes this method unattractive. Separation of sulfate and recycle of the radionuclides to the primary melter appears to be a practical method for treating the acid condensate. (auth)

24810 (ORNL-TM–1441) AN ECONOMIC ANALYSIS OF HIGH-LEVEL WASTE MANAGEMENT FOR FLUIDIZED-BED VOLATILITY PROCESSING OF POWER REACTOR FUELS. Suddath, J. C.; Blomeke, J. O. (Oak Ridge National Lab., Tenn.). Apr. 1, 1966. Contract W-7405-eng-26. 20p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Costs were estimated for management of major wastes from the fluidized-bed volatility processing of Zircaloy- and stainless-steel-clad UO_2 reactor fuels. Management alternatives consist of encapsulating the wastes without additional treatment, encapsulation following preparation of glassy solids, and encapsulation of the fission products as a glass following their separation from the inerts by a phosphoric acid leach. In all cases, the final products are shipped to a salt mine for final disposal. It was concluded that there is not a clear-cut economic incentive to make glasses or to leach the fission products, but that if these conversions are desirable for greater safety in handling and shipment, a substantial credit from cheaper management of the products can be applied against the cost of the treatment step. Also, more economic waste management cannot be cited as an advantage of volatility over aqueous processing in the fluidized-bed method for low-enrichment fuel. (auth)

24811 (Y–1531) MIXING OF FLUIDS IN SMALL-DIAMETER TANKS BY RECIRCULATION [Thesis]. Harrell, J. E. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Apr. 11, 1966. Contract W-7405-eng-26. 96p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Submitted to Univ. of Tennessee, Knoxville.

A theoretical treatment for the intermixing of fluid, resulting from recirculation in small-diameter tanks of large length-to-diameter ratio, was made. By applying a diffusional-type mixing model, relationships were developed for predicting the mixing time needed to disperse a tracer pulse to a small level of inhomogeneity with a system bulk contents. A linear correlation between the logarithm of the dimensionless mixing time and the logarithm of the system mixing number for a given small level of inhomogeneity was found to exist for mixing numbers less than 0.1. Experimental determinations of dispersion intensity and mixing time were made for tanks with length-to-diameter ratios up to 50. Significant departures were observed in a comparison of measured and published (obtained for very long straight lines) dispersion intensity data for Reynolds numbers less than about 20,000. Predicted mixing time based upon the developed mixing theory was found to compare favorably with measured mixing times when measured dispersion intensity data were applied, but to generate large relative errors when published dispersion data were used. (auth)

24812 FINGAL'S CAVE FOR FIXATION OF RADIOACTIVE WASTES IN GLASS. Brit. Chem. Eng., 8: 555(Aug. 1963).

Disposal of fission product wastes by fixation in glass is discussed as an alternative to the practice of evaporating the fission products followed by underground storage in stainless-steel tanks. A large experimental apparatus was set up for this purpose. The project was named FINGAL (Fixation in Glass of Active Liquors) and the hot cell, in which the experimental work will be carried out, was dubbed "Fingal's Cave." In the process a stream of the fission product waste solution in nitric acid is mixed with a stream of slurried borax and silica and the slurry is pumped into the top of a steel cylinder 5 ft long and 6 in. diameter. The cylinder is situated in a segmented furnace, which enables the input of heat to be regulated along the length of the cylinder. The oxides fuse to glass. Thus, glass is continuously formed in the vessel and when the level has risen to about 40 in. the operation is stopped and the glass is allowed to cool. The stream and nitric acid vapors produced leave the vessel and are conducted through a second cylindrical vessel identical with the first (except that this vessel contains a filter and absorber for dust and volatile ruthenium) to a condenser and scrubber system. When glass making is complete in

the first vessel, it is cooled and then removed from the furnace to storage. The second vessel is now moved into the furnace and a clean vessel with filter installed takes its place. A third vessel, containing an extra filter and absorber, is placed in series with the first two vessels, but since its capacity is large it is not moved through the process positions. (BBB)

24813 NEW DEVICE FOR PROCESSING SOLID WASTE AT THE SACLAY NUCLEAR RESEARCH CENTER. Cerre, Pierre; Mestre, Emile; Barral, Samuel; Lebrun, Pierre (CEN, Saclay, France). Bull. Inform. Sci. Tech. (Paris), No. 99, 73-82(Dec. 1965). (In French).

The services which produce radioactive waste nearly always use drums for its storage and transportation to the processing installation. The large number of drums containing metals, screenings and materials contaminated by fission products coming mainly from the dismantling of the Fontenay-aux-Roses plutonium plant has led to development of a press capable of compressing the drum and its contents. This installation which makes it possible to obtain a large reduction factor and to reduce considerably the cost of processing solid waste is described. (auth)

24814 BEHAVIOR OF STRONTIUM AND CESIUM DURING FIXATION OF RADIOACTIVE WASTES IN BASALT. Saidl, J.; Ralkova, J. (Inst. for Nuclear Research, Rez, Czechoslovakia). Collect. Czech. Chem. Commun., 31: 871-80(Feb. 1966). (In Czech).

Molten basalt possesses very good properties as a suitable material for the fixation of highly active wastes. A special advantage with respect to the usual glasses lies in the fact that its properties, especially its mechanical properties and chemical resistivity, can be improved by recrystallization. The extractability of ^{90}Sr and ^{137}Cs fused in basalt was followed. The values for the apparent diffusion coefficients were found in the region from 10^{-15} to 10^{-17} cm^2/sec at temperatures from 30 to 70°C. (tr-auth)

24815 ALGAL INFLUENCE ON RADIONUCLIDES IN SETTLING PONDS. Echo, John; Hawkins, D. B. (Idaho Operations Office, Idaho Falls). Nature, 209: 1105-7 (Mar. 12, 1966).

The influence of algae growing on settling ponds, through which low-level aqueous radioactive waste solutions are allowed to seep into the ground, on the chemical state of radionuclides in solution, and on exchange reactions with the basin alluvium was investigated. Results of tracer studies using ^{137}Cs and ^{85}Sr and a synthetic alluvium showed that exchange reactions of the radionuclides on the soil are not affected by cycling through algal cells; that algae concentrate radioactivity from very low levels in water to rather high levels in algal aggregation; and that dried algae can become windborne and be transported a considerable distance from the pond. It is concluded that an algicide should be used to control the growth of algae in radioactive-liquid disposal ponds. (C.H.)

GENERAL AND MISCELLANEOUS

24816 (ANL–6987) RSSR ROUTINE, A ROOT-SQUARING AND SUBRESULTANT PROCEDURE FOR FINDING ZEROS OF REAL POLYNOMIALS. Bareiss, Erwin H. (Argonne National Lab., Ill.); Hamelink, Ronald (Michigan State Univ., East Lansing). Oct. 1965. Contract W-31-109-eng-38. 73p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The theoretical background of the RSSR Routine, a program for finding simultaneously all roots of a real polynomial equation is described. Codes for the IBM-704 and CDC-3600 are described, including complete listings of FORTRAN statements. These codes are designed to solve polynomials of degree up to order 20 to 30, but dimensioning allows the possible solution of polynomial equations of degree up to 50. A set of sample problems is presented which may also serve to test other root-finding routines. (auth)

24817 (BNWL–113-14) PLUTONIUM ABSTRACTS. Volume 6, Number 2. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 31, 1966. Contract AT(45-1)-1830. 41p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

References (101) are given to journals, theses, and reports published from 1964 through Feb. 1966. The topics covered include: biology and medicine; chemistry; health and safety; metallurgy and ceramics; physics; and reactor technology. (P.C.H.)

24818 (BNWL–243) SOIL SURVEY—HANFORD PROJECT IN BENTON COUNTY, WASHINGTON. Hajek, B. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1966. Contract AT(45-1)-1830. 19p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A soil map and a descriptive report of Hanford Area soils grouped according to morphologic and genetic characteristics are presented. (C.H.)

24819 (IDO–12050) HIGH-EXPANSION FOAM FIRE CONTROL FOR RECORDS-STORAGE CENTERS. Beers, R. J. (Idaho Operations Office (AEC), Idaho Falls. Health and Safety Div.). Mar. 1966. 38p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Tests have indicated that high-expansion foam provides a fast and effective means for controlling and extinguishing records fires in typical storage arrays. Records in cardboard storage containers completely immersed in the foam for a period of two days received little or no damage. (P.C.H.)

24820 (LA–3364) CALCULATIONS OF THE THERMAL PROPERTIES OF HYDROGEN. Fisher, B. B. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Nov. 15, 1965. Contract W-7405-eng-36. 49p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

The theory and equations to compute the high-temperature, thermodynamic properties for real hydrogen gas are described. They were also developed for use in a computer program. The equations are for the thermodynamic properties of dissociating hydrogen for temperatures from 600 to 5000°K and for pressures from near zero to 340 atmospheres. The property equations were obtained through an equation of state which extends to the third virial coefficients. The most important virial coefficients, those of molecular hydrogen, were based upon new high-temperature hydrogen viscosity measurements. The coefficient of viscosity and the coefficient of thermal conductivity were also calculated for the same set of conditions. (auth)

24821 (NP–15948) STATENS RAD FOR ATOMFORSKNING REDOGORELSE FOR BUDGETARET, 1963–64. (Annual Report and Budget of Swedish Atomic Research Council, 1963–64). (Statens Rad for Atomforskning, Stockholm (Sweden)). 1965. 84p.

Nuclear research in the universities and other research organizations in Sweden is reported. The budget for 1963-64 is given with a breakdown of the various areas of study to be emphasized. Financial contributions to CERN are also tabulated. (J.S.R.)

24822 (TID–85(5th Rev.)) REPORT NUMBER SERIES USED BY THE DIVISION OF TECHNICAL INFORMATION IN CATALOGING REPORTS. Fifth Revised Edition. Mayfield, Hannah B.; White, Helen W. (comps.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Sept. 1965. 144p. Dep. CFSTI $4.00 cy, $1.00 mn.

An alphabetical listing of report series codes identified with the corporate or issuing organization and a listing of the organizations followed by report series each has used are included. (P.C.H.)

24823 (Y–1532) SPECTROGRAPHIC DETECTION OF TRACE ELEMENTS IN ALUMINUM METAL. Killeen, O. P. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). May 5, 1966. Contract W-7405-eng-26. 15p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The preparation of suitable samples and standards was a major problem in the spectrographic determination of impurities in aluminum metal. This was solved by dissolving the aluminum samples in aqua regia and thermally decomposing the resulting salt into aluminum oxide. Ten samples of aluminized Mylar were analyzed, and all were found to be quite impure in the common elements. Data are tabulated. (P.C.H.)

24824 LIABILITY, COVERAGE, AND STATE RESPONSIBILITY IN THE OPERATION OF THE "OTTO HAHN". Pelzer, N. (Univ., Goettingen, Ger.). Atomwirtschaft, 11: 183-8(Apr. 1966). (In German).

The present situation and legal problems in insuring the Otto Hahn are discussed. Liability, coverage, and state responsibility according to German law are reported. (J.S.R.)

24825 ANNUAL REPORT TO CONGRESS OF THE ATOMIC ENERGY COMMISSION FOR 1965. Washington, D. C., U. S. Atomic Energy Commission, 1966. 457p. GPO $1.50.

Developmental and promotional activities in the 1965 atomic energy program are discussed under the following topics: the industrial base, industrial relations, operational safety, source and special nuclear materials production, the nuclear defense effort, civilian nuclear power, nuclear space applications, auxiliary electric power for land and sea, military reactors, advanced reactor technology and nuclear safety research, the Plowshare Program isotopes and radiation development, facilities and projects for basic research, international cooperation, and nuclear education and information. Regulatory activities for licensing and regulating the atom, for reactors and other nuclear facilities, and for control of radioactive materials are discussed. Ajudicatory activities are also described. (M.C.G.)

24826 ATOMIC ENERGY LEGISLATION THROUGH 89th CONGRESS, 1st SESSION, JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, DECEMBER 1965. Washington, D. C., Joint Committee on Atomic Energy, 1965. 334p. GPO $1.00.

Amendments to the Atomic Energy Act of 1954, AEC authorization acts and amendments, the Euratom cooperation act and concurrent resolutions, the international atomic energy participation act, and the atomic energy community act are presented. (M.C.G.)

24827 DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-NINTH CONGRESS, FIRST SESSION, AUGUST 10, 11, AND SEPTEMBER 8, 1965. Washington, D. C., Joint Committee on Atomic Energy, 1965. 624p. GPO $2.00.

Topics covered include: AID financing of reactors, air pollution, breeder reactors, coal use, competition in nuclear industry, cost of coal-fired power, costs of nuclear power, desalination, education in the nuclear field, fast breeder reactors, fast reactor fuel tests, foreign sales, fuel cycle, fuel cycle guarantees, fuel inventory cost, reprocessing fuels, gas-cooled breeder reactors, nuclear power growth, heavy water organic reactors, design improvements in nonbreeder reactors, nuclear ships, indemnity legislation, isotope uses in industry, licensing, Long Island reactor proposal, maritime reactors, national laboratories, oceanographic programs, nuclear fuel cycles, operating contract award policy, plutonium, the plutonium recycle reactor, fabrication of pressure vessels, nuclear weapon proliferation, submarine propulsion by radioisotopes, regulatory jurisdiction, reliability of nuclear power, safeguards agreements and inspection, seed blanket reactor, siting, sodium component development, sodium pump test facility, steam-cooled breeder reactors, supercritical reactors, superheat reactors, toll enrichment, and uranium conversion to hexafluoride. (M.C.G.)

24828 INSTITUTE OF ENVIRONMENTAL SCIENCES 1965 ANNUAL TECHNICAL MEETING. PROCEEDINGS, APRIL 21, 22, 23, 1965, CHICAGO, ILL. Mt. Prospect, Ill., Institute of Environmental Sciences, 1965. 664p. $14.00. (CONF-650445).

Separate abstracts were prepared for 5 of the 87 papers included. The remaining papers deal with the space environment, environmental testing, cryogenics, weightlessness, and equipment and procedures for testing space vehicles. (D.C.W.)

For abstracts of individual papers see: 23273, 23524, 23525, 24578, and 24579.

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CORPORATE AUTHOR INDEX

This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

Each entry under a corporate author is a shortened version of the title of the publication, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

A

AEROJET-GENERAL CORP., AZUSA, CALIF.
Electrical insulation materials. SNAP-8 radiation effects test program. II., 20: 23521 (NASA-CR-54387)

AEROJET-GENERAL NUCLEONICS, SAN RAMON, CALIF.
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Surface waves at plane interface between vacuum and plasma with magnetostatic field normal to interface, 20: 24492 (AD-626144)
Upper atmosphere phenomena associated with solar flare of October 22, 1963, 20: 24208 (AD-626167)

AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OHIO. SCHOOL OF ENGINEERING.
Digital computer automation of whole-body radioisotope determination, 20: 23335 (AD-621120)
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AKTIEBOLAGET ATOMENERGI, STUDSVIK (SWEDEN).
Tritium hazards at Swedish reactors, 20: 23358 (CONF-640413, pp 40-52)

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Prog. rpt. on interactions between f-shell transition ions in non-metallic crystals, final, 9/65, 20: 24591 (TID-22848)

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Elk River reactor fuel cycle studies for second core, 20: 24733 (ACNP-66522)

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

ä	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is identifiable by the absence of a report number.

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included in cumulative indexes to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Gland and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings, e.g., Amino Acids rather than Acids, Amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases parenthetic modifying terms or inverted headings of the form Neutrons, Fast are used in preference to a direct entry that would result in the scattering of information. Organic compounds are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of Chemical Abstracts, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are alphabetized word-by-word. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out.

Examples:

M-Capture
  see Electron Capture
Magnesium
Magnesium Alloys
Manganese Fluorides
Manganese(II) Fluorides
Mesons
Mesons (π)
Mesons (ρ)
3-Pentanol, 2,4-Dimethyl-
2-Pentanol, 2-Methyl-
2-Pentanol, 4-Methyl-

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Alloys and Other Systems

Multicomponent alloys, except well-known trade names, are indexed under a main heading in the form "element alloy" for each element in the alloy. The modifier begins with element symbols for each component arranged alphabetically as if the English name for the element were spelled out.

Example: Copper-Gold Alloy is indexed
  Copper Alloys
    Cu-Au...
  Gold Alloys
    Cu-Au...

Well-known alloys such as Zircaloy-2 are indexed directly to the trade name; cross references referring from each component of the alloy to the entry for the trade name appear in cumulative indexes.

Multicomponent systems of non-metallic elements are indexed in a manner similar to alloys except the main heading used contains the word "Systems" in place of "Alloys."

Example: Silicon–Tungsten Systems are indexed
  Silicon Systems
    Si-W...
  Tungsten Systems
    Si-W...

Multicompound systems and mixtures of compounds are indexed under the main heading for each component com-

pound; the modifiers begin with an alphabetical listing of compound formulas.

Example: Lead Titanate–Lead Zirconate is indexed
Lead Titanates
$PbTiO_3$-$PbZrO_3$...
Lead Zirconates
$PbTiO_3$-$PbZrO_3$...

A mixed system of compounds and elements is indexed using a combined form of the above conventions, e.g., a dispersion of copper and alumina would be indexed

Aluminum Oxides
Al_2O_3-Cu...
Copper Systems
Al_2O_3-Cu..

Physical States and Configurations of Materials

Specification of the physical state, if other than normal, or geometric configuration of the material is included in the modifying phrase, i.e., liquid metals would be indexed to the metal with "liquid" in the modifier, and carbon crucibles would be indexed to Carbon with "crucibles" appropriately placed in the modifier and also to Crucibles if appropriate.

Modifying Phrases

The modifiers appearing under a main heading are written specifically to describe the relation of the item being indexed to that main heading. The modifier, therefore, will generally contain more useful information about that relation than will a title or a phrase written to be used under every main heading assigned to the item. Effort is exerted to begin the modifier with the word judged to be of greatest use to the greatest number of users; this, however, does not obviate the need to consider all modifiers under the main heading(s) of interest.

Modifiers are usually intended to form a meaningful phrase when combined with the main heading. Some are intended to be read following the main heading, e.g., the entry Hydrogen—sorption by charcoal is read "hydrogen sorption by charcoal"; however, as a result of placing the important word first, many modifiers must be arranged for smooth reading, e.g., Formaldehyde—yields in radiolysis of ethyl ether, effects of deuterium on is read "effects of deuterium on formaldehyde yields in radiolysis of ethyl ether" and Uranium—crystal structure of, effect of cooling rate on allotropic transformations in is read "effect of cooling rate on allotropic transformations in crystal structure of uranium." Prepositions are sometimes omitted if no ambiguity results.

Special characters are added to modifiers in the field of physics; if the modifier does not establish the experimental or theoretical character of a reference, a symbol (E), (T), or (E/T) is placed immediately after the modifying phrase and before the journal reference number. The value of this identification has been established by the American Institute of Physics.

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Reports, conference papers and proceedings, numbered translations, and patents abstracted during the period are included in this index. Each item is listed by report number; this is followed by the abstract number and a brief notation regarding public availability. The index entries show which reports are on file in the depository libraries, which reports have been published in open-literature journals (journal citation given), and which reports can be purchased (source and price). Whenever a report is identified by more than one number, cross references from secondary to primary report numbers are cited.

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65-801	20-23451	See AD-627323
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66-0004	20-24499	See AD-628029
AFRRI-CR–	(Non-AEC)	
65-2	20-23345	
65-4	20-23453	See AD-631318
65-7	20-23454	See AD-631319
AGN–	(Misc.)	
8169	20-23071	Dep. mn. CFSTI $1.00 cy, $0.50 mn
8177	20-22965	Dep. mn. CFSTI $2.00 cy, $0.50 mn

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ALO–		
1355-1	20-23455	Dep. mn. CFSTI $6.00 cy, $1.25 mn
AN–	(Misc.)	
1225(Vol.2)	20-24489	See AD-624486
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6987	20-24816	Dep. mn. CFSTI $3.00 cy, $0.75 mn
7060	20-22853	Dep. mn. CFSTI $4.00 cy, $1.00 mn
7083	20-22966	Dep. mn. CFSTI $4.00 cy, $0.75 mn
7108	20-24328	Dep. mn. CFSTI $4.00 cy, $0.75 mn
7139	20-23820	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7176	20-24669	Dep. mn. CFSTI $4.00 cy, $0.75 mn
ANL-Trans–		
294	20-24362	Dep. mn. CFSTI $1.00 cy, $0.50 mn; JCL $2.60 fs, $0.83 mf
APL-TDR–	(Misc.)	
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ARPA–	(Non-AEC)	
17	20-24585	See AD-627302
AWRE-O–	(British)	
5/66	20-22860	Dep. mn. BIS $4.00. HMSO 20s. 0d.
BAW–	(Misc.)	
267	20-23642	Dep. mn. CFSTI $2.00 cy, $0.50 mn
269	20-23072	Dep. mn. CFSTI $1.00 cy, $0.50 mn
BLG–	(Belgian)	
365(Vol.1)	20-23346	Dep. mn
BM-RI–	(Misc.)	
6771	20-23643	Bureau of Mines Free
BMI–	(Misc.)	
1765	20-23582	Dep. mn. CFSTI $2.00 cy, $0.50 mn
BN–	(Misc.)	
6512-02	20-23584	See EURAEC-1552
BNL–		
8832	20-23779	Acta Met., 14: 323-36(1966)
9067	20-22571	Dep. mn. CFSTI $1.00 cy, $0.50 mn
9169	20-23766	Dep. mn. CFSTI $3.00 cy, $0.75 mn
9226	20-22569	Copenhagen, Rhodos International Science Publishers, 1965
9513	20-23116	J. Phys. Chem., 70: 1098-1107(1966)
9616	20-24645	J. Appl. Phys., 37: 1032-3(1966)
9648	20-24648	J. Appl. Phys., 37: 1052-3(1966)
9780	20-23109	Inorg. Chem., 5: 699-700(1966)
10033	20-23195	Dep. mn. CFSTI $2.00 cy, $0.50 mn
10040	20-23875	Dep. mn. CFSTI $1.00 cy, $0.50 mn
10075	20-24333	Dep. mn. CFSTI $1.00 cy, $0.50 mn
10083	20-24334	Dep. mn. CFSTI $1.00 cy, $0.50 mn
10085	20-24335	Dep. mn. CFSTI $1.00 cy, $0.50 mn
10130	20-22861	Dep. mn. CFSTI $1.00 cy, $0.50 mn
10132	20-23644	Dep. mn. CFSTI $1.00 cy, $0.50 mn
BNWL–		
88	20-23767	Dep. mn. CFSTI $3.00 cy, $0.75 mn
113-14	20-24817	Dep. mn. CFSTI $2.00 cy, $0.50 mn
190	20-23768	Dep. mn. CFSTI $2.00 cy, $0.50 mn
202	20-23769	Dep. mn. CFSTI $1.00 cy, $0.50 mn
213	20-24809	Dep. mn. CFSTI $2.00 cy, $0.50 mn
234	20-24735	Dep. mn. CFSTI $4.00 cy, $0.75 mn
243	20-24818	Dep. mn. CFSTI $1.00 cy, $0.50 mn
BNWL-SA–		
55	20-23676	Carbon, 3: 257-9(1965)
132	20-22639	Brit. J. Exp. Pathol., 46: 577-82(1965)
282(Rev.)	20-23298	J. Amer. Vet. Med. Ass., 147: 1488-91 (1965)
556	20-23283	Dep. mn. CFSTI $2.00 cy, $0.50 mn
557	20-24787	Dep. mn. CFSTI $2.00 cy, $0.50 mn
572	20-23347	Dep. mn. CFSTI $1.00 cy, $0.50 mn
604	20-23770	Dep. mn. CFSTI $2.00 cy, $0.50 mn
625	20-22542	Dep. mn. CFSTI $1.00 cy, $0.50 mn
CALT–		
68-26	20-24003	CFSTI $3.00 cy, $0.75 mn
68-49	20-24026	Nuovo Cimento (10), 42: 737-42(1966)
CAPE–		
1212	20-23446	EM
1275	20-23232	EM
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1295	20-23509	EM
1304	20-23445	EM
1338	20-23245	EM
1351	20-23510	EM
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1359	20-23444	EM
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68	20-24336	Dep. mn
CEA-R–	(French)	
2553	20-22862	Dep. mn
2835	20-22863	Dep. mn
2839	20-23457	Dep. mn
2854	20-23645	Dep. mn
2873	20-23073	Dep. mn
2874	20-22611	Dep. mn
2886	20-23284	Dep. mn
2889	20-24788	Dep. mn
2897	20-22543	Dep. mn
2899	20-22544	Dep. mn
2901	20-23458	Dep. mn
2908	20-23348	Dep. mn
2914	20-22864	Dep. mn
2926	20-24301	Dep. mn
2931	20-23349	Dep. mn
2937	20-23213	Dep. mn
2946	20-23214	Dep. mn
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2964	20-24337	Dep. mn
2989	20-23196	Dep. mn
CEA-tr–	(French)	
A-1845	20-24363	Dep. mn. JCL $1.60 fs, $0.80 mf
CERN–	(European Organization for Nuclear Research)	
65-24(Vol.2)	20-24004	Dep. mn
65-24(Vol.3)	20-24009	Dep. mn
66-12	20-23821	Dep. mn
CF–	(Oak Ridge National Lab.)	
52-10-230(Del.)	20-23350	Dep. mn. CFSTI $6.00 cy, $1.25 mn
CLM–	(British)	
P-69	20-24196	Proc. Inst. Elec. Eng. (London), 113: 517-24(1966)
CONF-734–	20-22535	(Symposium on Genes and Chromosomes Structure and Function, Buenos Aires, Nov.-Dec. 1964) Nat. Cancer Inst. Monogr., No. 18, 1-354(1965)
CONF-758–	(American Physical Society Meeting, New York, Jan. 22–25, 1965)	
62	20-23877	Dep. mn. CFSTI $2.00 cy, $0.50 mn
CONF-600402–	(The Uses of Radioactive Isotopes and Nuclear Radiation in the U.S.S.R., All-Union Conference, Riga, Apr. 12–16, 1960)	
Vol.1	20-23529	For translation see AEC-tr-6466/1
CONF-640413–	20-23351	(Seminar on Protection Against Tritium Hazards, Le Vesinet, France, Apr. 16–18, 1964) Dep. mn
CONF-640814–	20-23921	(Reports of the All-Union Conference on Cosmic-Ray Physics, Apatity, U.S.S.R., Aug. 24–31, 1964) Izv. Akad. Nauk SSSR, Ser. Fiz., 29: Nos. 9 and 10, 1627-1961(1965)

Report No.	Abstract No.	Availability
CONF-650660–		(American Crystallographic Assn. and Mineralogical Society of America Joint Meeting, Gatlinburg, Tenn., June 27–July 2, 1965)
1	20-23185	ORINS. Gmelin, AED-CONF-65-154-1
CONF-650668–		(2nd International Symposium on Basic Environmental Problems of Man in Space, Paris, June 14–16, 1965)
3	20-22623	For translation see UCRL-Trans-1232
CONF-650704–		(IAEA Symposium on Thermodynamics, Vienna, July 22–27, 1965)
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CONF-650707–	20-21164	(IEEE Annual Conference on Nuclear and Space Radiation Effects, Ann Arbor, Mich., July 12–15, 1965) IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-12: 1-155(1965)
18	20-23805	ORINS
CONF-650923–		(5th International Conference on High Energy Accelerators, Frascati, Italy, Sept. 9–16, 1965)
27	20-23825	For translation see SLAC-Trans-34
28	20-23824	For translation see SLAC-Trans-29
CONF-650955–		(American Inst. of Aeronautics and Astronautics, Thermophysics Specialist Conference, Monterey, Calif., Sept. 13–15, 1965)
3	20-23184	ORINS
CONF-650968–		(European Society for Radiation Biology, Section on Genetical Effects, Annual Meeting, Utrecht, Sept. 16–18, 1965)
1	20-22618	See RT-BIO-(65)31
CONF-651004–		(9th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn., Oct. 12, 1965)
7	20-22956	ORINS
14	20-22878	See TRG-Report-1185
CONF-651009–		(Conference on Safety, Fuels and Core Design in Large Fast Power Reactors, Argonne, Oct. 11–14, 1965)
13	20-24766	ORAU. Gmelin, AED-CONF-65-307-13
CONF-651023–		(Symposium on Radioisotope Instruments in Industry and Geophysics, Warsaw, Oct. 18–22, 1965)
2	20-22959	ORINS
12	20-22958	ORINS
13	20-23280	ORINS
14	20-22964	ORINS
18	20-22961	ORINS
19	20-23569	ORINS
20	20-23568	ORINS
23	20-22960	ORINS
29	20-22962	ORINS
CONF-651106–	20-24638	(Conference on Magnetism and Magnetic Materials, San Francisco, Nov. 16–19, 1965) J. Appl. Phys., 37: 937-1489 (1966)
CONF-651126–		(American Physical Society, 7th Annual Meeting of the Division of Plasma Physics, San Francisco, Nov. 8–11, 1965)
11	20-24516	See UCID-5036
CONF-651206–	20-23527	(7th Annual Contractors Meeting, Washington, D. C., Dec. 6–8, 1965) Dep. mn. CFSTI $3.00 cy, $0.75 mn
CONF-651214–		(American Chemical Society, Southeast-Southwest Regional Meeting, Memphis, Tenn., Dec. 2–4, 1965)
1	20-22866	Dep. mn. CFSTI $3.00 cy, $0.50 mn
CONF-660107–		(American Physical Society Meeting, New York, Jan. 26–29, 1966)
1	20-24587	See COO-972-9
CONF-660206–		(Symposium on Neutron Noise, Waves, and Pulse

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CONF-640927–		(3rd All Union Conference on Radiochemistry, Liblice, Czechoslovakia, Sept.–Oct., 1964)
Vol.1	20-23206	[Rez] Ustav Jaderneho Vyzkumu Ceskoslovenska Akademie Ved, [1965].
Vol.2	20-23209	[Rez] Ustav Jaderneho Vyzkumu Ceskoslovenska Akademie Ved, [1965].
CONF-640928–	20-23032	(Symposium on Coordination Chemistry, Tihany, Hungary, Sept. 14–17, 1964) Akademiai Kiado, Budapest, 1965.
CONF-641027–	20-23307	(13th Session of the United Nations Scientific Committee on the Effects of Atomic Radiation, Geneva, Oct. 1964) WMO (World Meteorol. Organ.), Tech. Note No. 68, 1-194(1965)
CONF-641126–	20-22852	(1st Symposium on Nuclear Medicine, Mendoza, Argentina, Nov. 1964) Buenos Aires, Comision Nacional de Energia Atomica, [1965].
CONF-650203–		(National AIME Meeting, Chicago, Feb. 14–18, 1965)
12	20-22963	ORINS. Gmelin, AED-CONF-65-005-2
CONF-650218–	20-24256	(International University Sessions on Nuclear Physics, Schladming, Austria, Feb. 25–Mar. 10, 1965) Acta Phys. Austr., Suppl. II, 1-245(1965)
CONF-650325–		(National Assn. of Corrosion Engineers, 21st Annual Meeting, St. Louis, Mar. 15–19, 1965)
2	20-23619	ORINS. Gmelin, AED-CONF-65-037-4
CONF-650407–	20-554	(International Symposium on Fission Product Release and Transport Under Accident Conditions, Oak Ridge, Tenn., Apr. 1965)
14	20-23348	See CEA-R-2908
CONF-650445–	20-24828	(Annual Technical Meeting of the Institute of Environmental Sciences, Chicago, Apr. 21–23, 1965) $14.00.
CONF-650507–	20-23464	(IAEA Symposium on Radioisotope Sample Measurement Techniques in Medicine and Biology, Vienna, May 24–28, 1965) See STI-PUB-106
CONF-650513–		(American Ceramic Society, Annual Meeting, Philadelphia, May 4, 1965)
8	20-22967	Dep. mn. CFSTI $1.00 cy, $0.50 mn
CONF-650542–	20-24088	(Midwest Theoretical Conference, Columbus, May 14–15, 1965) Columbus, Ohio, Ohio State University, 1965.
CONF-650559–	19-47991	(American Institute of Chemical Engineers, 56th National Meeting, San Francisco, Calif., May 16–19, 1965) See GA-6126
6	20-23258	ORINS
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5	20-23758	ORINS. Gmelin, AED-CONF-65-149-12
6	20-23759	ORINS. Gmelin, AED-CONF-65-149-16
9	20-23039	ORINS. Gmelin, AED-CONF-65-149-2
CONF-650646–		(American Society for Testing and Materials, 68th Annual Meeting, Lafayette, Ind., June 13–18, 1965)
2	20-22957	ORINS. Gmelin, AED-CONF-65-148-3
CONF-650652–		(6th International Conference on Radiocarbon and Tritium Dating, Pullman, Wash., June 7–11, 1965)
15	20-23330	ORINS. Gmelin, AED-CONF-158-18
CONF-650655–		(Aerospace Technical Conference and Exhibit, Houston, Tex., June 21–24, 1965)
1	20-23246	ORINS. Gmelin, AED-CONF-65-159-1

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		Propagation, Gainesville, Feb. 14–16, 1966)
4	20-24710	See WAPD-T-1914
CONF-660208–		(Symposium on Solidification and Long-Term Storage of Highly Radioactive Wastes, Richland, Wash., Feb. 14–18, 1966)
17	20-23644	See BNL-10132
CONF-660303–		(American Physical Society, Conference of Neutron Cross Section Technology, Washington, D. C., Mar. 22–24, 1966)
4	20-24354	See ORNL-P-2026
5	20-24355	See RPI-328-50
6	20-24707	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7	20-24356	See RPI-328-51
8	20-24334	See BNL-10083
9	20-24335	See BNL-10085
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25	20-24347	See LA-DC-7618
CONF-660304–		(Institute of Electrical and Electronics Engineers, Scintillation and Semiconductor Counter Symposium, Washington, D. C., Mar. 2–4, 1966)
5	20-23465	See UCRL-16536
CONF-660306–		(American Physical Society, Conference on Isobaric Spin, Tallahassee, Mar. 17–19, 1966)
4	20-24333	See BNL-10075
CONF-660309–		(Conference on Pediatric Significance of Peacetime Radioactive Fallout, San Diego, Calif., Mar. 14–16, 1966)
1	20-23347	See BNWL-SA-572
CONF-660311–		(Symposium on Water Production Using Nuclear Energy, Tucson, Ariz., Mar. 30–Apr. 1, 1966)
2	20-24775	See ORNL-P-2071
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2	20-22861	See BNL-10130
CONF-660313–		(American Society of Mechanical Engineers, Gas Turbine Conference, Zurich, Mar. 14–17, 1966)
1	20-24737	See ORNL-P-2052
CONF-660405–		(Symposium on Radioecological Concentration Processes, Stockholm, Apr. 25–29, 1966)
3	20-23283	See BNWL-SA-556
CONF-660408–		(Instrument Society of America, Southeastern Conference and Exhibit, Augusta, Ga., Apr. 19–21, 1966)
2	20-24677	See DPSPU-66-30-3
3	20-24777	See DPSPU-66-30-6
CONF-660409–		(Libby/Cockcroft Meeting on Graphite Chemistry, Harwell, England, Apr. 25–26, 1966)
1	20-23600	See GA-7005
CONF-660410–		(6th Annual Symposium on Computers and Operations Research in Mineral Industries, University Park, Penn., Apr. 17–23, 1966)
1	20-23657	See UCRL-14759
CONF-660411–		(American Physical Society Meeting, Washington, D. C., Apr. 25–28, 1966)
1	20-24338	Dep. mn. CFSTI $1.00 cy, $0.50 mn
CONF-660511–		(International Symposium on Capsule Irradiation Experiments, Pleasanton, Calif., May 3–5, 1966)
1	20-23770	See BNWL-SA-604
CONF-660512–		(Electron Excitation of Atomic Vapor, Applications to Spectroscopy Seminar, Grenoble, France, May 23–26, 1966)
1	20-23880	See UCRL-14776
CONF-660513–		(International Symposium on Some Aspects of Strontium Metabolism, Annan, Scotland, May 5–6, 1966)
1	20-22542	See BNWL-SA-625
CONF-660514–		(3rd International Conference on Metallic Corrosion, Moscow, May 25, 1966)
1	20-23599	See COO-1319-36
CONF-660516–		(Annual Conference on Organic and Heavy Water Reactors, Winnipeg, Canada, May 30–June 1, 1966)
1	20-24787	See BNWL-SA-557
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1	20-23195	See BNL-10033
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1	20-23875	See BNL-10040
CONF-660605–		(Cryogenic Engineering Conference, Boulder, Colo., June 13–15, 1966)
1	20-24183	See LA-DC-7806
CONF-660606–		(American Nuclear Society Meeting, Denver, June 19–23, 1966)
1	20-24709	See RPI-328-52
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264-290	20-24031	Nuovo Cimento (10), 42: 878-93(1966)
427-47	20-24012	Dep. mn. CFSTI $1.00 cy, $0.50 mn
720-060	20-24339	Dep. mn. CFSTI $5.00 cy, $1.00 mn
841-5	20-23736	pp 197-211 of STI-PUB-109(Vol.2)
972-9	20-24587	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1198-358	20-23583	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1319-30	20-23597	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1319-34	20-23598	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1319-36	20-23599	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1404-3	20-22612	Dep. mn. CFSTI $2.00 cy, $0.50 mn
DCBRL–	(Canadian)	
478	20-22586	Can. J. Biochem., 44: 433-48(1966)
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66/2	20-24013	Dep. mn
66/4	20-24014	Dep. mn
DP–		
836	20-24676	Dep. mn. CFSTI $1.00 cy, $0.50 mn
996	20-23620	Dep. mn. CFSTI $2.00 cy, $0.50 mn
DPSPU–		
66-30-3	20-24677	Dep. mn. CFSTI $1.00 cy, $0.50 mn
66-30-6	20-24777	Dep. mn. CFSTI $2.00 cy, $0.50 mn
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1548	20-23621	Dep. mn. CFSTI $4.00 cy, $1.00 mn
1552	20-23584	Dep. mn. CFSTI $3.00 cy, $0.75 mn
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6179	20-24498	See AD-628018
6273	20-24302	Dep. mn. CFSTI $2.00 cy, $0.50 mn
6704	20-24538	J. Nucl. Energy: Pt. C, 8: 121-8(1966)
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6763	20-24684	Nucl. Eng. Design, 3: 163-82(1966)
6897	20-24303	
7005	20-23600	Dep. mn. CFSTI $2.00 cy, $0.50 mn
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3771-18	20-23585	Dep. mn. CFSTI $3.00 cy, $0.50 mn
4837	20-23601	Dep. mn. CFSTI $6.00 cy, $1.25 mn
5100E	20-23771	Dep. mn. CFSTI $7.00 cy, $1.75 mn
GNE-	(Non-AEC)	
65-10	20-23336	See AD-621270
GNE-Phys.-	(Non-AEC)	
65-4	20-23335	See AD-621120
HEPL-	(Misc.)	
391	20-24322	See AD-624270
406	20-23817	See AD-624271
HMI-B-	(German)	
47	20-23459	Dep. mn
HNS-		
58	20-23285	Dep. mn. CFSTI $3.00 cy, $0.50 mn
I-	(Misc.)	
A2412-3	20-23375	See NYO-2539-2
IBJ-	(Polish)	
See INR		
IC-	(Misc.)	
65-69	20-23581	Commun. Math. Phys., 1: 321-7(1966)
66/38	20-24093	Dep. mn
66/39	20-24094	Dep. mn
66/40	20-24095	Dep. mn
IDA-HQ-	(Non-AEC)	
65-4151	20-23316	See AD-625199
IDO-		
12050	20-24819	Dep. mn. CFSTI $2.00 cy, $0.50 mn
14650	20-23252	Dep. mn. CFSTI $3.00 cy, $0.50 mn
17107(Suppl.1)	20-24341	Dep. mn. CFSTI $1.00 cy, $0.50 mn
17148	20-24778	Dep. mn. CFSTI $3.00 cy, $0.50 mn
17158	20-24790	Dep. mn. CFSTI $3.00 cy, $0.50 mn
17161	20-24779	Dep. mn. CFSTI $2.00 cy, $0.50 mn

Report No.	Abstract No.	Availability
IFJ-	(Polish)	
See INP		
IKF-	(German)	
16	20-24791	Dep. mn
INR-	(Non-AEC)	
619/XV/E	20-22867	Dep.
673/XVII/C	20-23074	Dep.
IPPJ-	(Japanese)	
45	20-24501	Dep. mn
46	20-24502	Dep. mn
48	20-24503	Dep. mn
IPST-Cat.-	(Russian)	
1241	20-23529	For translation see AEC-tr-6466/1
IS-		
1283	20-24654	J. Appl. Phys., 37: 1248-9(1966)
1344	20-22968	Dep. mn. CFSTI $5.00 cy, $1.00 mn
JAERI-	(Japanese)	
1999	20-24504	Dep. mn
JINR-	(Russian)	
E-2580	20-24342	Dep. mn
JPL-TR-	(Non-AEC)	
32-871	20-24182	
JPRS-	(Non-AEC)	
34501	20-22801	CFSTI $1.00 cy, $0.50 mn
34578	20-23382	CFSTI $1.00 cy, $0.50 mn
34927	20-23383	CFSTI $1.00 cy, $0.50 mn
JUL-	(German)	
347-PC	20-22868	Dep. mn
JUL-Bibl.-	(German)	
10	20-22969	Dep. mn
KFK-	(German)	
382	20-24708	Dep. mn
388	20-23460	Dep. mn
LA-		
3364	20-24820	Dep. mn. CFSTI $3.00 cy, $0.50 mn
3468	20-22869	Dep. mn. CFSTI $2.00 cy, $0.50 mn
LA-DC-		
6751	20-24780	Dep. mn. CFSTI $3.00 cy, $0.75 mn
7363	20-23612	J. Nucl. Mater., 10: 212-14(1966)
7500	20-22561	Proc. Soc. Exp. Biol. Med., 121: 664-70 (1966)
7563	20-23611	J. Nucl. Mater., 10: 196-7(1966)
7603	20-24343	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7612	20-24344	ORAU
7613	20-24345	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7617	20-24346	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7618	20-24347	ORAU
7620	20-24348	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7622	20-24349	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7625	20-22870	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7731	20-24761	Nucl. News, 9: No. 4, 21-4(1966)
7774	20-24350	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7799	20-24304	ORAU
7806	20-24183	Dep. mn. CFSTI $2.00 cy, $0.50 mn
LA-tr-		
66-21	20-23662	Dep. mn. CFSTI $1.00 cy, $0.50 mn; JCL $1.10 fs, $0.80 mf
LNF-	(Italian)	
65/50	20-23822	Dep. mn
66/2	20-23421	Dep. mn
66/3	20-23461	Dep. mn
66/7	20-24575	Dep. mn
66/13	20-23253	Dep. mn

Report No.	Abstract No.	Availability
MATT–		
389	20-24539	J. Nucl. Energy: Pt. C, 8: 145-55(1966)
MIT–	**(Misc.)**	
905-52	20-22854	Dep. mn. CFSTI $4.00 cy, $0.75 mn
2098-149	20-24352	Dep. mn. CFSTI $1.00 cy, $0.50 mn
2098-223	20-24015	Dep. mn. CFSTI $3.00 cy, $0.75 mn
MITNE–	**(Misc.)**	
52	20-24781	See N-65-11146
62	20-24792	
MND–	**(Misc.)**	
3247	20-23992	See AD-626593
N–	**(Misc.)**	
65-10044	20-23906	CFSTI $3.00 cy, $0.75 mn
65-11073	20-23520	CFSTI $2.00 cy, $0.50 mn
65-11146	20-24781	CFSTI $5.00 cy, $1.00 mn
65-11397	20-24588	CFSTI $1.00 cy, $0.50 mn
65-11409	20-23647	CFSTI $1.00 cy, $0.50 mn
65-13446	20-23772	CFSTI $2.00 cy, $0.50 mn
65-14402	20-23269	CFSTI $6.00 cy, $1.50 mn
65-14601	20-23994	CFSTI $3.00 cy, $0.75 mn
65-14949	20-24505	CFSTI $1.00 cy, $0.50 mn
65-14956	20-23528	CFSTI $1.00 cy, $0.50 mn
65-15147	20-24265	CFSTI $1.00 cy, $0.50 mn
65-29998	20-23373	
65-32549	20-23878	CFSTI $3.00 cy, $0.50 mn
65-32721	20-23879	CFSTI $3.00 cy, $0.75 mn
65-33116	20-24506	
65-33177	20-23422	CFSTI $1.00 cy, $0.50 mn
65-33253	20-24096	CFSTI $3.00 cy, $0.75 mn
65-33285	20-24209	CFSTI $2.00 cy, $0.50 mn
66-11248	20-23648	
66-15346	20-24507	CFSTI $4.00 cy, $0.75 mn
66-15390	20-24508	CFSTI $3.00 cy, $0.75 mn
66-15427	20-24509	CFSTI $3.00 cy, $0.75 mn
66-15440	20-24510	CFSTI $1.00 cy, $0.50 mn
66-15441	20-24511	CFSTI $2.00 cy, $0.50 mn
66-15620	20-23907	CFSTI $3.00 cy, $0.75 mn
66-15632(Paper 2)	20-24353	
66-15634	20-24353	See N-66-15632(Paper 2)
66-15979	20-24512	CFSTI $3.00 cy, $0.50 mn
66-16038	20-23270	CFSTI $4.00 cy, $0.75 mn
66-16138	20-23995	CFSTI $3.00 cy, $0.50 mn
NAA-SR–		
11140	20-23773	Dep. mn. CFSTI $3.00 cy, $0.50 mn
11502	20-24782	Dep. mn. CFSTI $4.00 cy, $1.00 mn
NAA-SR-Memo–		
6532	20-23649	Dep. mn. CFSTI $1.00 cy, $0.50 mn
6957	20-23650	Dep. mn. CFSTI $1.00 cy, $0.50 mn
NADC-AE–	**(Non-AEC)**	
6518	20-23533	See AD-625721
NASA-CF–	**(Non-AEC)**	
59563	20-23647	See N-65-11409
NASA-CR–	**(Misc.)**	
458	20-23651	CFSTI $2.00 cy, $0.50 mn
45575	20-23995	See N-66-16138
54079	20-23269	See N-65-14402
54124	20-23994	See N-65-14601
54387	20-23521	CFSTI $1.85 cy, $1.00 mn
54389	20-24303	See GA-6897
54406	20-23878	See N-65-32549
54663	20-23648	See N66-11248
55248	20-23270	See N-66-16038
59403	20-23906	See N-65-10044
59524	20-23520	See N-65-11073
59533	20-24781	See N-65-11146
59553	20-24588	See N-65-11397
59928	20-23772	See N-65-13446
60155	20-23528	See N-65-14956
60179	20-24265	See N-65-15147
64455	20-23879	See N-65-32721
64636	20-24096	See N-65-33253
64820	20-24209	See N-65-33285
68537	20-24509	See N-66-15427
69290	20-24507	See N-66-15346
69343	20-24508	See N-66-15390
69377	20-24511	See N-66-15441
69387	20-24510	See N-66-15440
69433	20-23907	See N-66-15620
69655	20-24512	See N-66-15979
NASA-TM–	**(Misc.)**	
X-1054	20-24505	See N-65-14949
X-56772	20-23422	See N-65-33177
NASA-TN–	**(Misc.)**	
D-3407	20-23271	CFSTI $2.00 cy, $0.50 mn
NAVWEPS–	**(Non-AEC)**	
8824	20-23871	See AD-625519
NEVIS–	**(Misc.)**	
144	20-23819	See AD-627351
NIRS–	**(Japanese)**	
4	20-22530	Dep. mn
NOLC–	**(Non-AEC)**	
637	20-23452	See AD-631225
NP–	**(AEC File No. for Non-AEC Reports)**	
15892	20-24678	ORAU
15927	20-23462	Dep. mn
15943	20-24016	Dep. mn
15948	20-24821	
15954	20-24184	Dep. mn
NRC–	**(Canadian)**	
8815	20-23096	Can. J. Phys., 44: 525-47(1966)
NRL–	**(Misc.)**	
6333	20-23516	See AD-625440
NWL–	**(Non-AEC)**	
1962	20-24181	See AD-627919
NYO–		
901-21	20-23918	Science, 151: 1381-4(1966)
2539-2	20-23375	Dep. mn. CFSTI $3.00 cy, $0.75 mn
2807-12	20-23075	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3114-14	20-23254	Dep. mn. CFSTI $6.00 cy, $1.25 mn
3399-19	20-24027	Nuovo Cimento (10), 42: 804-13(1966)
3399-34	20-24097	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3399-62	20-24148	Phys. Rev. Lett., 16: 825-7(1966)
3560-3	20-24589	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3642-1	20-23996	Dep. mn. CFSTI $0.50 cy, $0.50 mn
ORNL–		
3510	20-23652	Dep. mn. CFSTI $6.00 cy, $1.25 mn
3913	20-22855	Dep. mn. CFSTI $5.00 cy, $1.00 mn
ORNL-P–	**(Misc.)**	
1113	20-22572	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1158	20-24590	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1194	20-23775	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1221	20-24266	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1252	20-23653	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1263	20-24679	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1291	20-23607	Carbon, 3: 269-75(1965)
1316	20-22573	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1331	20-22574	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1372	20-22730	Radiat. Res., 27: 616-29(1966)
1525	20-24389	Nucl. Phys., 80: 500-4(1966)
1526	20-23132	Nature, 209: 678-80(1966)
1565	20-23115	J. Phys. Chem., 70: 1031-7(1966)
1628	20-24540	J. Nucl. Energy: Pt. C, 8: 157-8(1966)
1712	20-24421	Nucl. Sci. Eng., 25: 31-6(1966)
1728	20-22987	Inorg. Chem., 5: 666-8(1966)
1938	20-22883	Anal. Chem., 38: No. 5, 251R-61R(1966)
2023	20-23728	Phys. Rev. Lett., 16: 727-9(1966)
2026	20-24354	Dep. mn. CFSTI $1.00 cy, $0.50 mn
2052	20-24737	Dep. mn. CFSTI $2.00 cy, $0.50 mn
2071	20-24775	Dep. mn. CFSTI $1.00 cy, $0.50 mn
ORNL-TM–		
951	20-24576	Dep. mn. CFSTI $1.00 cy, $0.50 mn

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1435	20-23654	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1437	20-23603	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1441	20-24810	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1460	20-23463	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1480	20-22873	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1481	20-22874	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1496	20-23236	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1505(Pt.1)	20-23535	Dep. mn. CFSTI $2.00 cy, $0.50 mn
ORNL-tr-		
969	20-23384	Dep. mn. JCL $1.60 fs, $0.83 mf
970	20-23385	Dep. mn. JCL $1.00 fs, $0.50 mf
971	20-23386	Dep. mn. JCL $1.60 fs, $0.80 mf
ORO-		
597	20-23321	Dep. mn. CFSTI $4.00 cy, $0.75 mn
2670-10	20-22875	Dep. mn. CFSTI $5.00 cy, $1.00 mn
P-	**(Misc.)**	
3270(RAND)	20-24206	See AD-624776
PAN-	**(Polish)**	**(This series of reports was terminated in 1965. Subsequent reports are identified by the code INR.)**
PATENTS	**(British)**	**(4s. 6d. each, U. K. Patent Office)**
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1,022,003	20-24767	
1,022,126	20-23247	
1,022,158	20-24768	
1,022,168	20-24320	
1,022,246	20-24769	
1,022,354	20-24770	
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1,023,133	20-24723	
1,023,259	20-24687	
1,023,273	20-24688	
1,023,510	20-24689	
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PATENTS	**(French)**	
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1,192,270	20-24690	
1,196,192	20-24724	
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1,350,142	20-24693	
1,366,741	20-24694	
1,378,856	20-24695	
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1,202,911	20-24696	
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1,204,341	20-23248	
1,206,096	20-23635	
1,206,594	20-23233	
1,207,518	20-24728	
1,209,222	20-24698	
1,209,673	20-24729	
1,209,674	20-24719	
1,210,093	20-23512	
1,210,094	20-23513	
1,210,095	20-24730	
1,210,096	20-24731	
1,210,498	20-24720	
1,210,500	20-24699	
1,212,228	20-24573	
1,212,304	20-23594	
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1964-612	20-23570	
1964-3015	20-23234	
1964-3511	20-23514	
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1964-6156	20-24806	
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1964-9120	20-23249	
1964-9725	20-23595	
1964-9970	20-23187	
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1964-10280	20-23841	
1964-10675	20-24700	
1964-10681	20-23596	
1964-10692	20-23636	
1964-11220	20-23449	
1964-11559	20-24701	
1964-11560	20-23040	
1964-11728	20-23576	
1964-11922	20-23041	
1964-11999	20-24321	
1964-12000	20-23250	
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1964-14360	20-23842	
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3,238,107	20-24808	
3,238,108	20-24732	
3,239,422	20-24702	
3,239,745	20-24000	
3,240,675	20-24773	
3,240,677	20-24703	
3,242,053	20-24774	
3,242,354	20-24001	
PEL-	**(South African)**	
85(Suppl.1)	20-23322	Dep. mn
97	20-24738	Dep. mn
PRNC-		
80	20-22575	Dep. mn. CFSTI $3.00 cy, $0.50 mn
Q-	**(Misc.)**	
B2028-8	20-23647	See N-65-11409
R-	**(Misc.)**	
1	20-24510	See N-66-15440
2	20-24511	See N-66-15441
536	20-23819	See AD-627351
R-OU-	**(Non-AEC)**	
157(Vol.1)	20-23264	See AD-624701
157(Vol.2)	20-23265	See AD-624702
157(Vol.3)	20-23266	See AD-624703
RAD-TR-	**(Non-AEC)**	
64-42	20-23269	See N-65-14402
RADC-TR-	**(Non-AEC)**	
65-353	20-24491	See AD-625897
66-28	20-24494	See AD-627530
RFP-		
643	20-23655	Dep. mn. CFSTI $3.00 cy, $0.50 mn
644	20-22876	Dep. mn. CFSTI $2.00 cy, $0.50 mn
744	20-23604	Dep. mn. CFSTI $1.00 cy, $0.50 mn
RHEL-R-	**(British)**	
107	20-23776	Dep. mn. BIS $1.40. HMSO 7s.
RISO-M-	**(Danish)**	
313	20-23423	Dep. mn
351	20-23424	Dep. mn

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Report No.	Abstract No.	Availability
RL-SEP–		
673	20-23215	Dep. mn. CFSTI $1.00 cy, $0.50 mn
RLE-QPR–		
80	20-23809	See TID-22735
RLO–		
1780-1	20-22617	Dep. mn. CFSTI $3.00 cy, $0.75 mn
RM–	(Misc.)	
4385-PR	20-24300	See AD-626147
4763-PR	20-24178	See AD-625268
4788-ARPA	20-24180	See AD-627885
RMI–	(Misc.)	
4	20-23622	Dep. mn. CFSTI $3.00 cy, $0.75 mn
RPI–	(Misc.)	
328-50	20-24355	Dep. mn. CFSTI $1.00 cy, $0.50 mn
328-51	20-24356	Dep. mn. CFSTI $1.00 cy, $0.50 mn
328-52	20-24709	Dep. mn. CFSTI $1.00 cy, $0.50 mn
RT-BIO–	(Italian)	
(65)31	20-22618	Dep. mn
RT-FI–	(Italian)	
(65)53	20-24793	Dep. mn
RTD-TDR–	(Non-AEC)	
63-3096(Vol.2)	20-23267	See AD-627597
63-3096(Vol.4)	20-23268	See AD-627870
63-3096(Vol.5)	20-23342	See AD-627516
RTI–		
2513-T9	20-23321	See ORO-597
SAN–		
409-29	20-23255	Dep. mn. CFSTI $4.00 cy, $0.75 mn
SC-R–		
65-992	20-23425	Dep. mn. CFSTI $3.00 cy, $0.50 mn
SC-RR–		
65-491(Vol.2)	20-23377	Dep. mn. CFSTI $2.00 cy, $0.50 mn
65-615	20-23605	Dep. mn. CFSTI $3.00 cy, $0.50 mn
SGAE-M–	(Austrian)	
4/1966	20-24721	Dep. mn
SGAE-PH–	(Austrian)	
32/1965	20-23572	Dep. mn
SIT-P–	(Misc.)	
147(5/65)	20-24500	See AD-622815
SLAC-PUB–		
141	20-23893	Rev. Mod. Phys., 38: 346-58(1966)
SLAC-Trans–		
29	20-23824	Dep. mn. CFSTI $2.00 cy, $0.50 mn. JCL $3.60 fs, $1.34 mf
34	20-23825	Dep. mn. CFSTI $1.00 cy, $0.50 mn. JCL $1.60 fs, $0.80 mf
SRS–	(British)	
307	20-22619	Dep. mn. BIS $2.20. HMSO 11s. 0d.
STI-PUB–	(International Atomic Energy Agency)	
98	20-23378	IAEA: $1.50; S31,50; 9/-stg; F Fr 6,-; DM 4,80
106	20-23464	IAEA: $15.00; Sch 315,-; £4.10.0; F Fr 60; DM 52,50
109(Vol.1)	20-22970	IAEA: $11.00; S231,-; £3.6.0; F Fr 44,-; DM 38,50
109(Vol.2)	20-22971	IAEA: $13.00; S273,-; £3.18.0; F Fr 52,-; DM 45,50
STL–	(Misc.)	
9801-6015-RU-000	20-24511	See N-66-15441
SUDAER–	(Non-AEC)	
206	20-24265	See N-65-15147
TG–	(Misc.)	
442	20-23905	See AD-627416
230-T464	20-23272	
230-T466	20-24210	
TID–		
85(5th Rev.)	20-24822	Dep. CFSTI $4.00 cy, $1.00 mn
4204	20-22531	Dep. mn. CFSTI $5.50 cy, $2.25 mn
5360(Suppl.2)	20-23379	Dep. mn. CFSTI $0.50 cy, $0.50 mn
20893(Rev.)	20-23426	Dep. mn. GPO $0.20
21702	20-22547	Dep. mn. CFSTI $1.00 cy, $0.50 mn
21907	20-22576	Dep. mn. CFSTI $1.00 cy, $0.50 mn
21908	20-22577	Dep. mn. CFSTI $1.00 cy, $0.50 mn
21914	20-22578	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22095	20-24396	Nucl. Phys., 80: 617-24(1966)
22283	20-23111	J. Chem. Eng. Data, 11: 256-60(1966)
22594	20-23823	GPO $0.60
22735	20-23809	Dep. mn. CFSTI $6.00 cy, $1.50 mn
22823	20-22620	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22837	20-22536	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22841	20-23380	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22842	20-22621	Dep. mn. CFSTI $3.00 cy, $0.75 mn
22846	20-22877	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22848	20-24591	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22851	20-22972	Dep. mn. CFSTI $1.00 cy, $0.50 mn
TN–	(Non-AEC)	
6	20-24494	See AD-627530
TN-N–	(Non-AEC)	
775	20-23577	See AD-625328
TR–	(Misc.)	
1	20-23639	See AD-625687
2	20-24495	See AD-627614
17	20-24506	See N-65-33116
28	20-24496	See AD-627681
65-114	20-23419	See AD-626405
TRG-Report–	(British)	
977	20-24592	Dep. BIS $1.00. HMSO 5s. 0d.
1151	20-23656	Dep. BIS $0.30. HMSO 1s. 9d.
1161	20-23777	Dep. BIS $0.50. HMSO 2s. 6d.
1185	20-22878	Dep. BIS $0.40. HMSO 2s.
TT–	(Canadian)	
66-30941	20-22801	See JPRS-34501
66-31018	20-23382	See JPRS-34578
66-31365	20-23383	See JPRS-34927
UAPL–	(Non-AEC)	
24	20-23990	See AD-625575
UCB–	(Misc.)	
34P110-2	20-22537	Dep. mn. CFSTI $1.00 cy, $0.50 mn
UCID–		
5036	20-24516	Dep. mn. CFSTI $1.00 cy, $0.50 mn
UCLA–		
12-540	20-22566	Toxicol. Appl. Pharmacol., 8: 37-43(1966)
12-566	20-22727	Radiat. Res., 27: 566-9(1966)
UCRL–		
11936	20-23522	Dep. mn. CFSTI $1.00 cy, $0.50 mn
11985	20-24017	Dep. mn. CFSTI $1.00 cy, $0.50 mn
11998	20-24098	Dep. mn. CFSTI $2.00 cy, $0.50 mn
12049-T	20-24229	Dep. mn. CFSTI $2.00 cy, $0.50 mn
12101	20-24230	Dep. mn. CFSTI $2.00 cy, $0.50 mn
12210	20-23908	Dep. mn. CFSTI $1.00 cy, $0.50 mn
12326	20-23323	Dep. mn. CFSTI $2.00 cy, $0.50 mn
12328	20-23324	Dep. mn. CFSTI $2.00 cy, $0.50 mn
12427	20-23586	Dep. mn. CFSTI $1.00 cy, $0.50 mn
14127	20-24099	Dep. mn. CFSTI $1.00 cy, $0.50 mn
14171	20-23237	Dep. mn. CFSTI $2.00 cy, $0.50 mn
14341-T	20-24120	Nuovo Cimento (10), 42: 743-56(1966)
14538	20-24357	Dep. mn. CFSTI $3.00 cy, $0.75 mn
14702	20-23286	Dep. mn. CFSTI $1.00 cy, $0.50 mn
14759	20-23657	Dep. mn. CFSTI $1.00 cy, $0.50 mn

Report No.	Abstract No.	Availability
14776	20-23880	Dep. mn. CFSTI $1.00 cy, $0.50 mn
16280	20-22603	Radiat. Res., 27: 676-93(1966)
16281	20-22604	Radiat. Res., 27: 694-709(1966)
16492	20-22548	Dep. mn. CFSTI $3.00 cy, $0.75 mn
16536	20-23465	Dep. mn. CFSTI $1.00 cy, $0.50 mn
16580	20-22858	Dep. mn. CFSTI $6.00 cy, $1.50 mn
16608	20-24599	J. Chem. Phys., 44: 3130-1(1966)
16808	20-24231	Dep. mn. CFSTI $3.00 cy, $0.75 mn
UCRL-Trans-		
1232	20-22623	Dep. mn. CFSTI $3.00 cy, $0.75 mn. JCL $8.00 fs, $2.66 mf
UJV-	**(Czechoslovakian)**	
956/63	20-22973	Dep. mn
1453/65	20-23606	Dep. mn
1493	20-24670	Dep. mn
UR-		
875-79	20-24100	Dep. mn. CFSTI $1.00 cy, $0.50 mn
USNRDL-TR-	**(Misc.)**	
965	20-23343	See AD-631529
981	20-23381	
983	20-22570	See AD-631144
989	20-22610	See AD-632049
VANL-TME-	**(Misc.)**	
1384	20-24361	Dep. mn. CFSTI $2.00 cy, $0.50 mn
WAPD-T-		
1914	20-24710	Dep. mn. CFSTI $1.00 cy, $0.50 mn
WAPD-TM-	**(Misc.)**	
455	20-23778	Dep. mn. CFSTI $5.00 cy, $1.00 mn
564	20-24711	Dep. mn. CFSTI $2.00 cy, $0.50 mn
WCAP-	**(Misc.)**	
3269-42A	20-23658	Dep. mn. CFSTI $3.00 cy, $0.75 mn
3269-42B	20-23659	Dep. mn. CFSTI $4.00 cy, $1.00 mn
6073	20-24739	Dep. mn. CFSTI $4.00 cy, $0.75 mn
WERL-	**(Misc.)**	
1114-2	20-23660	Dep. mn. CFSTI $2.00 cy, $0.50 mn
8844-10	20-23578	Dep. mn. CFSTI $1.00 cy, $0.50 mn
8844-11	20-23661	Dep. mn. CFSTI $2.00 cy, $0.50 mn
WIS-TCI-	**(Misc.)**	
93	20-24096	See N-65-33253
WL-TR-	**(Non-AEC)**	
64-134	20-23373	See N-65-29998
Y-		
1531	20-24811	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1532	20-24823	Dep. mn. CFSTI $1.00 cy, $0.50 mn

Appendix I

NUCLEAR SCIENCE ABSTRACTS CATEGORY DEFINITIONS

BIOLOGY AND MEDICINE

General

Information applicable to the main subject category but which is outside specific subcategories or is a combination of three or more subcategories.

Ecology

Movement of radioactive and other materials through organisms and the environment and influence of these materials on natural communities. The measurement and hazards of radioactive materials in the biosphere are included in the subcategory *Radiation Hazards and Protection* of this category.

Metabolism, Tissue Distribution, and Toxicology

Chemical and metabolic processes in living organisms and the absorption, metabolism, utilization, and toxicological significance of materials ingested, inhaled, or otherwise entering the organisms. Studies performed to establish maximum allowable concentrations of radioactive materials are included in the subcategory *Radiation Hazards and Protection* of this category.

Radiation Effects on Biochemicals

Radiation effects on biochemical materials such as enzymes, DNA, biological extracts, etc.

Radiation Effects on Tissues

Radiation effects on tissues, tissue cultures, organs, and unicellular organisms.

Radiation Effects Therapy and Countermeasures

Use of biological extracts, chemical compounds, or drugs to alter, prevent, simulate, or treat the effects of radiation on organisms or their components. The use of special shields to prevent radiation effects is included in the subcategory *Radiation Hazards and Protection* of this category.

Radiation Hazards and Protection

Measurement and hazards of radioactive material in the biosphere; studies of maximum permissible concentrations of radioactive materials on organisms or their components; and the use of rules, procedures, and equipment to reduce radiation exposure. Users of this subcategory should also see the subject category HEALTH AND SAFETY.

Radiotherapy and Radiodiagnosis

Use of both external and internal radiation sources in the diagnosis and therapy of disease. Also includes all phases of radiation equipment, procedure, and effectiveness.

CHEMISTRY

This category excludes *biochemistry*, which is found in the category BIOLOGY AND MEDICINE; *corrosion* which is a subcategory of METALS, CERAMICS, AND OTHER MATERIALS; and *geochemistry* which is included in the category GEOLOGY, METEOROLOGY, AND MINERALOGY.

General

Information applicable to the main subject category but which is outside specific subcategories or is a combination of three or more subcategories.

Analytical Procedures

Qualitative and quantitative procedures, radiochemical analysis, neutron-activation analysis, and mass spectroscopy.

Inorganic and Physical Chemistry

Chemistry of elements and inorganic compounds and chemical thermodynamics. Chemistry of elements and inorganic compounds is also included in the subcategories *Analytical Procedures*, *Radiation Chemistry*, *Radiochemistry*, and *Separation Processes and Procedures* of this category and in the category METALS, CERAMICS, AND OTHER MATERIALS. Radiation effects on chemical properties and reactions are included in the subcategory *Radiation Chemistry* of this category.

Organic Chemistry

Chemical and physical properties and reactions of organic compounds and systems of compounds. Equipment and procedures for investigating such properties and reactions are also included. For radiation effects on organic compounds, see the subcategory *Radiation Chemistry* of this category. Also see the subcategory *Separation Processes and Procedures* of this category.

Radiation Chemistry

Radiation effects on chemical properties and reactions, radiation effects on physical properties of nonmetallic elements and compounds and organic compounds. Also includes the generation of visible light as a result of radiation. Radiation effects on biological materials are included in the subcategories *Radiation Effects on Tissues* and *Radiation Effects on Biochemicals* of the category BIOLOGY AND MEDICINE. Radiation effects on metals and intermetallic compounds are included in the category METALS, CERAMICS, AND OTHER MATERIALS.

Radiochemistry

Chemistry of radioactive materials and special chemical procedures and equipment required as a result of the presence of radiation. Also includes the preparation and calibration of isotopic sources of ionizing radiation. Neutron sources are included in the subcategory *Neutron Physics* in the category PHYSICS. See also the subcategory *Separation Processes and Procedures* of this category and the category WASTE DISPOSAL AND PROCESSING.

Separation Processes and Procedures

Chemistry and chemical engineering for processing uranium and thorium ores and reactor fuel and breeder materials. Also includes chemical separations not designed for analytical purposes or for isotopic separations of an element. Analytical separations are included in the subcategory *Analytical Procedures* of this category, and separations of isotopes of an element are included in the subcategory *Separation and Production* of the category ISOTOPE TECHNOLOGY.

ENGINEERING

General

Information applicable to the main subject category but which is outside specific subcategories or is a combination of three or more subcategories.

Applications of Nuclear Explosions

Engineering applications of nuclear explosions or simulated nuclear explosions.

Facilities and Equipment

Plants, plant facilities, and equipment not designed for specific application in one of the other categories.

Heat Transfer and Fluid Flow

Theoretical studies and engineering applications of heat transfer and fluid flow. For thermodynamics and magnetofluiddynamics, see the subcategory *Fluid Physics and Thermodynamics* of the category PHYSICS.

Materials Testing

Information primarily concerned with equipment, methods, and techniques for destructive or nondestructive testing. When the material is of primary interest, information on testing (including corrosion and erosion) is included in the category METALS, CERAMICS, AND OTHER MATERIALS.

Protective Structures

Design, construction, and effectiveness of blast and fallout shelters and other protective structures.

Space Propulsion

Design, development, testing, and evaluation of electric, ion, nuclear, plasma jet, and other propulsion methods for space use.

Vacuum Engineering

Design and construction of vacuum systems and equipment (e.g., vacuum pumps). Excludes properties of materials under vacuum environment and vacuum systems and equipment that are more appropriately categorized according to the application (e.g., a vacuum system specifically intended for an accelerator is included in the subcategory *Accelerators* of the category PHYSICS).

GEOLOGY, METEOROLOGY, AND MINERALOGY

General

Information applicable to the main subject category but which is outside specific subcategories or is a combination of three or more subcategories.

Meteorology

Atmospheric and weather conditions, climatology, general meteorological problems, and meteorological studies made for the purpose of obtaining information on the movement of air-borne particulate matter. Meteorology included in site-selection reports is included in the subcategory *Site Survey and Selection.*

Natural Radioactivity and Fallout

Ground levels and movement of radioactive materials, both natural and artificial, and elemental and isotopic compositions of minerals.

Site Survey and Selection

Reactor and plant site-selection studies.

Techniques and Equipment

The use of radiometric techniques and equipment in geology and mineralogy, e.g., age estimation and well logging techniques. Also seismology associated with nuclear-explosion detection.

Thorium and Uranium Minerals

Structures and properties of thorium and uranium minerals.

HEALTH AND SAFETY

Critical limits for moving and storing fissionable, radioactive, and toxic materials; experience in applied health physics; the development of, and experience with, personnel-protection procedures; and general industrial- and radiation-hazards analyses. Excludes studies performed to establish maximum allowable concentrations and limits of exposure, which are included in the subcategory *Radiation Hazards and Protection* of the category BIOLOGY AND MEDICINE.

INSTRUMENTATION

This category excludes the specific applications of an instrument. These are categorized by the subject of the application.

General

Design, testing, and use of instruments, except radiation detection, where these aspects of instrumentation are the main subjects.

Radiation Detection

Radiation-detection instruments and their components.

Radiation Effects

Effects of radiation on any instrument or instrument component.

ISOTOPE TECHNOLOGY

General

Information applicable to the main subject category but which is outside specific subcategories or is a combination of two or more subcategories.

Industrial Applications

Applications to industrial processes and equipment for such applications. Applications to basic research are found under such categories as CHEMISTRY.

Power Application

Applications of radioisotopes in the production of electric or thermal energy or thrust.

Separation and Production

Separation of isotopes of one element in microquantities or macroquantities. Separation of isotopes of different elements is included in the subcategory *Separation Processes and Procedures* of the category CHEMISTRY.

MATHEMATICS AND COMPUTERS

Pure mathematics; statistics; and the design, development, and operation of computers. Information on applied mathematics and computer applications is categorized according to the application (e.g., computers used as simulators of various devices and pro-

cesses are categorized in the same manner as the device or process simulated; computer codes and applied mathematics are categorized on the basis of the application).

METALS, CERAMICS, AND OTHER MATERIALS

The term "other materials" refers to such substances as plastics, rubbers, other elastomers, wood, concrete, graphite, and petroleum.

General

Information applicable to the main subject category but which is outside specific subcategories or is a combination of three or more subcategories.

Corrosion

Corrosion and erosion studies that appear to be directed toward specific applications. Excludes studies primarily concerned with physical chemistry, reaction kinetics, etc., which are included in the category CHEMISTRY.

Fabrication

Fabrication methods, procedures, and equipment, including those for fuel elements and reactor components.

Properties and Structure

Mechanical, physical, and structural properties.

Radiation Effects

Effects of radiation on mechanical, physical, and structural properties. Chemical effects of radiation are included in the subcategory *Radiation Chemistry* of the category CHEMISTRY.

PHYSICS

General

Information which falls under the main subject category but which is outside specific subcategories or is a combination of three or more subcategories.

Accelerators

Theory, design, development, construction, and operation of high voltage machines and particle accelerators and their components. Also experimental and theoretical studies of charged-particle beam motion in electric and magnetic fields pertinent to accelerator beam bending, stability, or transport.

Astrophysics and Cosmology

Origin and cosmic abundances of elements, isotopic composition and radiation exposure ages of meteorites, stellar processes, and stellar and interstellar magnetic fields.

Atomic Physics

Physical properties and theory of atoms and molecules and their interactions, reactions, and scattering. Also experimental and theoretical studies of mesic atoms and molecules and the production of atomic and molecular beams and mechanisms of atomic beam bombardment of materials.

Cosmic Radiation

Origin, intensity variations, acceleration processes, etc., of cosmic radiation. For the properties of specific cosmic particles or the use of cosmic radiation merely as a source of high-energy particles, see the subcategories *Elementary Particles and Radiations* and *Nuclear Properties and Reactions* of this category, depending on the emphasis.

Direct Energy Conversion

Equipment, techniques, and theory of direct energy conversion, including magnetohydrodynamic cells and thermionic cells.

Elementary Particles and Radiations

Experimental and theoretical studies of the interactions and properties of particular particles or radiations. Also studies on positronium and muonium. Users should also see the subcategory *Field Theory, Scattering Theory, and Symmetries* of this category. The diffusion of particles and radiations in shielding materials and configurations is included in the subcategory *Shielding* of this category.

Field Theory, Scattering Theory, and Symmetries

General scattering theory and the applications of quantum field theory and group theory to the interactions or properties of elementary particles in general or to types of particles. For applications to particular particles, see the subcategory *Elementary Particles and Radiations* of this category.

Fluid Physics and Thermodynamics

The structure, properties, and dynamics of liquids and gases, electrodynamics, magnetohydrodynamics, and thermodynamics. Also phenomena of electric discharges and shock propagation in gases. Superfluidity is included in the subcategory *Low Temperature Physics* of this category. Users should also see the category *Plasma Physics and Thermonuclear Processes* of this category.

Geophysics

Geomagnetic phenomena and upper atmosphere physics, particle kinetics and geomagnetic trapping in radiation belts, and phenomena resulting from solar wind-geomagnetic field interactions.

Gravitation, Quantum Mechanics, and Relativity Theory

Theory on gravitational quanta and waves, quantum electrodynamics, and general and special relativity theory.

Low Temperature Physics

Cryogenics, superconductivity, and superfluidity. Applications are found under categories for the applications.

Neutron Physics

Experimental and mathematical treatments of neutron absorption, attenuation, moderation, multiplication, scattering, etc., in real and hypothetical media. Also the development and calibration of neutron generators and sources. Neutron physics studies conducted for a specified application are categorized according to the application (e.g., the category REACTOR TECHNOLOGY and the subcategory *Shielding* of this category). Neutron reactions with specific nuclei are included in the subcategory *Nuclear Properties and Reactions* of this category.

Nuclear Properties and Reactions

Experimental and theoretical studies relating to nuclear properties and reactions.

Plasma Physics and Thermonuclear Processes

Fundamental plasma experiments and theory and experimental and theoretical studies relating to controlled release of energy from thermonuclear reactions. Also the theory, design, and development of equipment for plasma and thermonuclear research. Electric discharge phenomena, electrodynamics, and magnetohydrodynamics are included in the subcategory *Fluid Physics and Thermodynamics* of this category.

Shielding

Theoretical and experimental studies relating to the diffusion, attenuation, absorption, and scattering of particles and radiations in shielding materials and configurations. For information on the fabrication of shielding materials and configurations, see the subcategory *Fabrication* of the category METALS, CERAMICS, AND OTHER MATERIALS.

Solid State Physics

Crystallography, the theory of the structure of metals, alloys, and ionic crystals, cohesive forces, band structure, thermal

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vibration, intrinsic photoconductivity, plasticity, lattice defects, color centers, and dislocation theory. Users of this subcategory should also see the subcategory *Inorganic and Physical Chemistry* in the subject category CHEMISTRY and the subcategory *Properties and Structure* of the category METALS, CERAMICS, AND OTHER MATERIALS.

REACTOR TECHNOLOGY

General

Information applicable to the main subject category but which is outside specific subcategories or is a combination of three or more subcategories.

Auxiliaries and Components

Design and construction of auxiliaries, components, control systems, and instrumentation not intended for a specific reactor.

Criticality Studies

Theoretical and experimental studies of neutron physics and parameters of unspecified reactors.

Design and Feasibility

Design and feasibility studies of reactor types not designated as power, process heat, production, propulsion, research, or test and not associated with a specific reactor.

Fuels

Design and theory of fuel elements not associated with a specific reactor. Metallurgy of fuel-element materials is included in the category METALS, CERAMICS, AND OTHER MATERIALS. Studies on nuclear properties and reactions in support of fuel-element technology are included in the subcategory *Nuclear Properties and Reactions* of the category PHYSICS. Fuel burnup cycle analysis and economic studies are included in the subcategory *Power Reactors* of this category.

Power and Power-Breeder Reactors

Design, construction, feasibility, operation, and economics of specific reactors and classes of reactors. Also includes auxiliaries, components, and criticality studies for such reactors. Dual-purpose reactors are included in the subcategory *Process Heat Reactors* of this category.

Process Heat Reactors

Dual-purpose reactors and reactors designed to produce heat for uses other than the production of electricity or propulsion. Also includes auxiliaries, components, and criticality studies for such reactors.

Production Reactors

Design, construction, feasibility, economics, and operation of reactors devoted primarily to the production of fissionable materials or isotopes. Also includes auxiliaries, components, and criticality studies for such reactors.

Propulsion and Space

Design, construction, feasibility, economics, and operation of reactors for the propulsion of vehicles (land, water, air, and space). Also includes auxiliaries, components, and criticality studies for such reactors. The vehicles themselves are included only if the influence on the reactor is considered.

Research and Test Reactors

Design, construction, feasibility, economics, and operation of reactors used for radiation-effects studies and other basic research. Also includes auxiliaries, components, and criticality studies for such reactors.

WASTE DISPOSAL AND PROCESSING

Chemistry and chemical engineering for the storage, disposal, and control of radioactive waste materials, including the treat-

ment of waste materials prior to disposal, such as concentration, neutralization, filtration, or calcination. Safety aspects of radioactive waste handling and disposal are included in the category HEALTH AND SAFETY. Ecological aspects of waste materials are included in the subcategory *Ecology* of the category BIOLOGY AND MEDICINE. Some radiochemical aspects are included in the subcategory *Radiochemistry* of the category CHEMISTRY. Fuel-element processing is included in the subcategory *Separation Processes and Procedures* of the category CHEMISTRY.

GENERAL AND MISCELLANEOUS

This category contains abstracts of both AEC and non-AEC originated broad summary type documents with diverse subject matter.

Appendix II

JOURNAL LIST

This is a list of journals and their abbreviations arranged alphabetically by the abbreviation used in *NSA*. Titles marked by an asterisk (*) are those that are scanned regularly. Titles without asterisks are journals from which some abstracts were taken during Volume 20, Numbers 1 through 12.

The Russian journals identified by a dagger (†) are available commercially in complete English translation.

Cross references have been included for some non-English language titles as well as for variant forms of titles used in this list. For journals on the present scanning list that fall in either of these categories, the asterisk appears only with the form of the title used for *NSA*. Some journals which have undergone name changes in recent years have been so identified parenthetically after the title. The original language title for a translated journal is given in parentheses after the English title.

Abhandl. Deut. Akad. Wiss. Berlin, Kl. Chem., Geol. Biol.
Abhandlungen der Deutschen Akademie der Wissenschaften zu Berlin, Klasse fuer Chemie, Geologie und Biologie *(Germany)*

Abstr. Bulg. Sci. Lit., Math., Phys., Astron., Geophys., Geod.
*Abstracts of Bulgarian Scientific Literature, Mathematics, Physics, Astronomy, Geophysics, Geodesy *(Bulgaria)*

Acad. Repub. Pop. Rom., Stud. Cercet. Biochim.
Academia Republicii Populare Romine, Institutul de Biochemie, Studii si Cercetari de Biochimie *(Romania)*

Acad. Repub. Pop. Rom., Stud. Cercet. Fiz.
Academia Republicii Populare Romine, Institutul de Fizica Atomica si Institutul de Fizica, Studii si Cercetari de Fizica *(Romania)*

Acad. Repub. Pop. Rom., Stud. Cercet. Fiziol.
Academia Republicii Populare Romine, Institutul de Fiziologie Normala si Patologica "Dr. D. Danielopolu," Studii si Cercetari de Fiziologie *(Romania)*

Acta Anat.
*Acta Anatomica *(Switzerland)*

Acta Biochim. Pol.
Acta Biochimica Polonica *(Poland)*

Acta Biochim. Pol. (Engl. Transl.)
*Acta Biochimica Polonica (English Translation) *(Poland)*

Acta Biol. Exp. Sinica
Acta Biologiae Experimentalis Sinica
see Shih Yen Sheng Wu Hsueh Pao

Acta Biol. Med. Ger.
Acta Biologica et Medica Germanica *(Germany)*

Acta Bot. Acad. Sci. Hung.
Acta Botanica Academiae Scientiarum Hungaricae *(Hungary)*

Acta Chem. Scand.
*Acta Chemica Scandinavica *(Denmark)*

Acta Chim. Acad. Sci. Hung.
*Acta Chimica Academiae Scientiarum Hungaricae *(Hungary)*

Acta Cient. Venezol.
*Acta Cientifica Venezolana *(Venezuela)*

Acta Crystallogr.
*Acta Crystallographica *(Denmark)*

Acta Cytol.
*Acta Cytologica *(U. S.)*

Acta Dermato-Venereol.
Acta Dermato-Venereologica *(Sweden)*

Acta Geophys. Pol.
*Acta Geophysica Polonica *(Poland)*

Acta Gerontol.
*Acta Gerontologica *(Italy)*

Acta Gynaecol. Obstet. Hispano Lusitana
*Acta Gynaecologica et Obstetrica Hispano Lusitana *(Portugal)*

Acta Histochem.
*Acta Histochemica *(Germany)*

Acta IMEKO
*Acta IMEKO *(Hungary)*

Acta Isotop.
*Acta Isotopica *(Italy)*

Acta Med. Biol. (Niigata)
Acta Medica et Biologica (Niigata) *(Japan)*
(Japan)

Acta Med. Hidalg.
*Acta Medica Hidalguense *(Mexico)*

Acta Med. Iran.
*Acta Medica Iranica *(Iran)*

Acta Med. Okayama
*Acta Medicinae Okayama *(Japan)*

Acta Med. Philippina
Acta Medica Philippina *(Philippines)*

Acta Med. Pol.
*Acta Medica Polona *(Poland)*

Acta Med. Scand.
Acta Medica Scandinavica *(Sweden)*

Acta Met.
*Acta Metallurgica *(U. S.)*

Acta Microbiol. Pol.
*Acta Microbiologica Polonica *(Poland)*

Acta Microbiol. Sinica
Acta Microbiologica Sinica
see Wei Sheng Wu Hsueh Pao

Acta Morphol. Acad. Sci. Hung.
Acta Morphologica Academiae Scientiarum Hungaricae *(Hungary)*

Acta Morphol. Neer.-Scand.
*Acta Morphological Neerlando-Scandinavica *(Netherlands)*

Acta Neurochir.
Acta Neurochirurgica *(Austria)*

Acta Neurol. Latinoamer.
*Acta Neurologia Latinoamericana *(Uruguay)*

Acta Neuropathol.
Acta Neuropathologica *(Germany)*

Acta Neuropsiquiat. Argent.
*Acta Neuropsiquiatrica Argentina *(Argentina)*

Acta Orthopaed. Scand.
Acta Orthopaedica Scandinavica *(Denmark)*

Acta Paediat.
*Acta Paediatrica *(Sweden)*

Acta Pathol. Jap.
*Acta Pathologica Japonica *(Japan)*

Acta Pathol. Microbiol. Scand.
Acta Pathologica et Microbiologica Scandinavica *(Denmark)*

Acta Phys. Acad. Sci. Hung.
*Acta Physica Academiae Scientiarum Hungaricae *(Hungary)*

Acta Phys. Austr.
*Acta Physica Austriaca *(Austria)*

Acta Phys. Austr., Suppl.
*Acta Physica Austriaca, Supplementum *(Austria)*

Acta Physiol. Acad. Sci. Hung.
Acta Physiologica Academiae Scientiarum Hungaricae *(Hungary)*
Acta Physiol. Pol.
*Acta Physiologica Polonica *(Poland)*
Acta Physiol. Scand.
Acta Physiologica Scandinavica *(Sweden)*
Acta Phys. Pol.
*Acta Physica Polonica *(Poland)*
Acta Phys. Sinica
Acta Physica Sinica
see Wu Li Hsueh Pao
Acta Radiol., Suppl.
*Acta Radiologica, Supplementum *(Sweden)*
Acta Radiol. Therapy, Phys., Biol.
*Acta Radiologica. Therapy, Physics, Biology *(Sweden)*
Acta Rheum. Scand.
*Acta Rheumatologica Scandinavica *(Sweden)*
Actas Dermo-Sifilog.
*Actas Dermo-Sifilograficas *(Spain)*
Acta Soc. Med. Upsalien.
*Acta Societatis Medicorum Upsaliensis *(Sweden)*
Acta Tech. Acad. Sci. Hung.
Acta Technica Academiae Scientiarum Hungaricae *(Hungary)*
Acta Unio Int. Contra Cancr.
Acta Unio Internationalis Contra Cancrum *(Belgium)*
Acta Univ. Carolinae, Med., Suppl.
Acta Universitatis Carolinae, Medica, Supplementum *(Czechoslovakia)*
Acta Urol. Jap.
Acta Urological Japonica
see Hinyokika Kiyo
Acta Virol. (Prague)
*Acta Virologica (Prague) *(Czechoslovakia)*
Advanced Energy Conversion
*Advanced Energy Conversion *(England)*
Advances Anal. Chem. Instrum.
*Advances in Analytical Chemistry and Instrumentation *(U. S.)*
Advances Appl. Microbiol.
*Advances in Applied Microbiology *(U. S.)*
Advances Astron. Astrophys.
Advances in Astronomy and Astrophysics *(U. S.–England)*
Advances At. Mol. Phys.
*Advances in Atomic and Molecular Physics *(U. S.)*
Advances Cancer Res.
*Advances in Cancer Research *(U. S.)*
Advances Chem. Eng.
*Advances in Chemical Engineering *(U. S.)*
Advances Chem. Ser.
*Advances in Chemistry Series *(U. S.)*
Advance. Sci.
Advancement of Science, The *(England)*
Advances Comp. Physiol. Biochem.
*Advances in Comparative Physiology and Biochemistry *(U. S.)*
Advances Electron. Electron Phys.
*Advances in Electronics and Electron Physics *(U. S.)*
Advances Fluorine Chem.
*Advances in Fluorine Chemistry *(U. S.)*
Advances Food Res.
*Advances in Food Research *(U. S.)*
Advances Genet.
*Advances in Genetics *(U. S.)*
Advances Geophys.
*Advances in Geophysics *(U. S.)*
Advances Heat Transfer
*Advances in Heat Transfer *(U. S.)*
Advances Inorg. Chem. Radiochem.
*Advances in Inorganic Chemistry and Radiochemistry *(U. S.–England)*
Advances Internal Med.
Advances in Internal Medicine *(U. S.)*
Advances Nucl. Sci. Technol.
*Advances in Nuclear Science and Technology *(U. S.)*
Advances Organometal. Chem.
*Advances in Organometallic Chemistry *(U. S.)*
Advances Org. Chem.
*Advances in Organic Chemistry: Methods and Results *(U. S.)*
Advances Photochem.
*Advances in Photochemistry *(U. S.)*
Advances Phys.
*Advances in Physics *(England)*
Advances Phys. Org. Chem.
*Advances in Physical Organic Chemistry *(U. S.)*
Advances Radiat. Biol.
*Advances in Radiation Biology *(U. S.)*
Advances Spectros.
*Advance in Spectroscopy *(U. S.)*
Advances Struct. Res. Diffr. Methods
*Advances in Structure Research by Diffraction Methods *(U. S.–Germany)*
Advances Tracer Methodol.
*Advances in Tracer Methodology *(U. S.)*
Advances Virus Res.
Advances in Virus Research *(U. S.–England)*
Advances Waste Treat. Res.
*Advances in Waste Treatment Research *(U. S.)*
A E G Mitt.
*A E G Mitteilungen *(Germany)*
AEI (Ass. Elec. Ind.) Eng.
*AEI (Associated Electrical Industries) Engineering *(England)*
Aerospace Med.
*Aerospace Medicine (formerly The Journal of Aviation Medicine) *(U. S.)*
Aerztl. Forsch.
Aerztliche Forschung *(Germany)*
Afinidad
Afinidad *(Spain)*
Afr. Franc. Chir.
*Afrique Francaise Chirurgicale *(Algeria)*
Aggiorn. Mal. Infez.
*Aggiornamenti sulle Malattie da Infezione *(Italy)*
Agr. Biol. Chem. (Tokyo)
*Agricultural and Biological Chemistry (Tokyo) *(Japan)*
Agri Hort. Genet.
Agri Hortique Genetica *(Sweden)*
Agrokhimiya
Agrokhimiya *(U.S.S.R.)*
Agron. J.
Agronomy Journal *(U. S.)*
Agron. Lusitana
*Agronomia Lusitana *(Portugal)*
AIAA (Amer. Inst. Aeronaut. Astronaut.) J.
*AIAA (American Institute of Aeronautics and Astronautics) Journal (combining the ARS Journal and the Journal of Aerospace Sciences) *(U. S.)*
AIAA (Amer. Inst. Aeronaut. Astronaut.) Student J.
AIAA (American Institute of Aeronautics and Astronautics) Student Journal *(U. S.)*
A.I.Ch.E. (Amer. Inst. Chem. Eng.) J.
*A.I.Ch.E. (American Institute of Chemical Engineers) Journal *(U. S.)*
Akad. Nauk Ukr. RSR, Inst. Teploenerg., Zb. Prats
*Akademiya Nauk Ukrain'skoi RSR, Institut Teploenergetiki, Zbirnik Prats *(Ukrainian S.S.R.)*
Akusherstvo Ginekol.
Akusherstvo i Ginekologiya *(U.S.S.R.)*
Alexandria Med. J.
*Alexandria Medical Journal, The *(Egypt)*
Algerie Med.
*Algerie Medicale *(Algeria)*
Allison Res. Eng.
*Allison Research and Engineering *(U. S.)*
Alloy Dig. Cb-6
Alloy Digest Cb-6 *(U. S.)*
Alluminio
Alluminio *(Italy)*
Aluminium
Aluminium *(Germany)*
Amer. Ceram. Soc. Bull.
*American Ceramic Society Bulletin, The *(U. S.)*
Amer. Heart J.
American Heart Journal *(U. S.)*
Amer. Ind. Hyg. Ass. J.
*American Industrial Hygiene Association Journal *(U. S.)*
Amer. J. Bot.
*American Journal of Botany *(U. S.)*
Amer. J. Clin. Pathol.
*American Journal of Clinical Pathology *(U. S.)*
Amer. J. Dig. Dis.
American Journal of Digestive Diseases, The *(U. S.)*
Amer. J. Dis. Children
American Journal of Diseases of Children *(U. S.)*

Amer. J. Human Genet.
*American Journal of Human Genetics, The *(U. S.)*
Amer. J. Med. Electron.
American Journal of Medical Electronics *(U. S.)*
Amer. J. Obstet. Gynecol.
American Journal of Obstetrics and Gynecology *(U. S.)*
Amer. J. Pathol.
*American Journal of Pathology, The *(U. S.)*
Amer. J. Phys.
*American Journal of Physics *(U. S.)*
Amer. J. Physiol.
*American Journal of Physiology, The *(U. S.)*
Amer. J. Proctol.
American Journal of Proctology *(U. S.)*
Amer. J. Public Health
American Journal of Public Health and The Nation's Health *(U. S.)*
Amer. J. Roentgenol.
American Journal of Roentgenology *(U. S.)*
Amer. J. Roentgenol., Radium Therapy Nucl. Med.
*American Journal of Roentgenology, Radium Therapy and Nuclear Medicine, The *(U. S.)*
Amer. J. Surg.
American Journal of Surgery, The *(U. S.)*
Amer. J. Trop. Med. Hyg.
American Journal of Tropical Medicine and Hygiene *(U. S.)*
Amer. J. Vet. Res.
*American Journal of Veterinary Research *(U. S.)*
Amer. Mineral.
*American Mineralogist, The *(U. S.)*
Amer. Natur.
*American Naturalist *(U. S.)*
Amer. Rev. Respirat. Dis.
American Review of Respiratory Diseases *(U. S.)*
Amer. Soc. Metals, Trans. Quart.
*American Society for Metals, Transactions Quarterly *(U. S.)*
Amer. Surg.
American Surgeon *(U. S.)*
An. Acad. Brasil. Cienc.
*Anais da Academia Brasileira de Ciencias *(Brazil)*
Anal. Abstr.
*Analytical Abstracts *(England)*
Anal. Biochem.
*Analytical Biochemistry *(U. S.)*
Anal. Chem.
*Analytical Chemistry *(U. S.)*
Anal. Chim. Acta
*Analytica Chimica Acta *(Netherlands)*
Analyst
*Analyst, The *(England)*
An. Brasil. Dermatol. Sifilog.
*Anais Brasileiros de Dermatologia e Sifilografia *(Brazil)*
An. Brasil. Ginecol. (Rio de Janeiro)
*Anais Brasileiros de Ginecologia (Rio de Janeiro) *(Brazil)*
Angew. Chem. Int. Ed. Engl.
*Angewandte Chemie. International Edition in English *(U. S.–Germany)*
Angiologia (Barcelona)
*Angiologia (Barcelona) *(Spain)*
Anglo-German Med. Rev.
Anglo-German Medical Review *(Germany)*
An. Hosp. Mil. Cent. (Lima, Peru)
*Anales del Hospital Militar Central (Lima, Peru) *(Peru)*
Anim. Behav.
Animal Behaviour *(England)*
An. Inst. Corachan (Barcelona)
*Anales del Instituto Corachan (Barcelona) *(Spain)*
An. Inst. Med. Trop. (Lisbon)
*Anais Instituto de Medicina Tropical (Lisbon) *(Portugal)*
An. Inst. Oncol. "Angel H. Roffo"
*Anales del Instituto de Oncologia "Angel H. Roffo" *(Argentina)*
An. Med. Cir.
*Anales de Medicina y Cirugia *(Spain)*
Ann. Acad. Sci. Fenn., Ser. A VI
*Annales Academiae Scientiarum Fennicae, Series A VI. Physica *(Finland)*
Ann. Allergy
*Annals of Allergy *(U. S.)*
Ann. Anat. Pathol.
*Annales d'Anatomie Pathologique *(France)*
Ann. Appl. Biol.
Annals of Applied Biology, The *(England)*
Ann. Astrophys.
*Annales d'Astrophysique *(France)*
Ann. Biochem. Exp. Med. (Calcutta)
*Annals of Biochemistry and Experimental Medicine (Calcutta) *(India)*
Ann. Biol. Clin. (Paris)
Annales de Biologie Clinique (Paris) *(France)*
Ann. Chem.
Annalen der Chemie, Justus Liebigs *(Germany)*
Ann. Chim. (Rome)
Annali di Chimica (Rome) *(Italy)*
Ann. Chir. Gynaecol. Fenn.
*Annales Chirurgiae et Gynaecologiae Fenniae *(Finland)*
Ann. Chir. Plastique, Semaine Hop.
Annales de Chirurgie Plastique, Archives de la Ste Francaise de Chirurgie Plastique et Reconstructive, La Semaine des Hopitaux *(France)*
Ann. Entomol. Soc. Amer.
Annals of the Entomological Society of America *(U. S.)*
Ann. Human Genet.
Annales of Human Genetics *(England)*
Ann. Inst. Henri Poincare
Annales de l'Institut Henri Poincare *(France)*
Ann. Inst. Henri Poincare, Sect. A
*Annales de l'Institut Henri Poincare, Section A. Physique Theorique *(France)*
Ann. Inst. Henri Poincare, Sect. B
*Annales de l'Institut Henri Poincare, Section B. Calcul des Probilities et Statistique *(France)*
Ann. Inst. Pasteur
Annales de l'Institut Pasteur *(France)*
Ann. Internal Med.
Annals of Internal Medicine *(U. S.)*
Ann. Int. Geophys. Year
*Annals of the International Geophysical Year *(England)*
Ann. Med. Exp. Biol. Fenn. (Helsinki)
Annales Medicinae Experimentalis et Biologiae Fenniae (Helsinki) *(Finland)*
Ann. N. Y. Acad. Sci.
*Annals of the New York Academy of Sciences *(U. S.)*
Ann. Occup. Hyg.
*Annals of Occupational Hygiene *(England)*
Ann. Odonto-Stomatol.
Annales Odonto-Stomatologiques *(France)*
Ann. Ostet. Ginecol.
*Annali di Ostetricia e Ginecologia *(Italy)*
Annot. Zool. Jap.
Annotationes Zoologicae Japonenses *(Japan)*
Ann. Paediat. Fenn.
*Annales Paediatriae Fenniae *(Finland)*
Ann. Paediat. Jap.
*Annales Paediatrici Japonici, Kioto Universitatis *(Japan)*
Ann. Phys. (N. Y.)
*Annals of Physics (New York) *(U. S.)*
Ann. Phys. (Paris)
*Annales de Physique (Paris) *(France)*
Ann. Physik
*Annalen der Physik *(Germany)*
Ann. Physiol. Veg.
Annales de Physiologie Vegetale *(France)*
Ann. Radioelec.
*Annales de Radioelectricite *(France)*
Ann. Radiol.
*Annales de Radiologie *(France)*
Ann. Rep. Jap. Ass. Radiat. Res. Polym.
Annual Report of the Japanese Association for Radiation Research on Polymers
see Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo
Ann. Rep. Nat. Inst. Genet. (Misima, Jap.)
Annual Report of the National Institute of Genetics (Misima, Japan) *(Japan)*
Ann. Rev. Astron. Astrophys.
Annual Review of Astronomy and Astrophysics *(U. S.)*
Ann. Rheum. Dis.
*Annals of the Rheumatic Diseases *(England)*
Ann. Sclavo
*Annali Sclavo *(Italy)*
Ann. Soc. Sci. Brux. Ser. I
*Annales de la Societe Scientifique de Bruxelles. Serie I *(Belgium)*
Ann. Surg.

Annals of Surgery *(U. S.)*

Ann. Technol. Agr.
Annales de Technologie Agricole *(France)*

Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. AA
*Annales Universitatis Mariae Curie-Sklodowska, Lublin-Polonia, Sectio AA *(Poland)*

Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. D
*Annales Universitatis Mariae Curie-Sklodowska, Lublin-Polonia, Sectio D *(Poland)*

Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. E
*Annales Universitatis Mariae Curie-Sklodowska, Lublin-Polonia, Sectio E *(Poland)*

Annu. Rep. Radiat. Center Osaka Prefect.
*Annual Report of the Radiation Center of Osaka Prefecture *(Japan)*

Annu. Rev. Med.
*Annual Review of Medicine *(U. S.)*

Annu. Rev. Nucl. Sci.
*Annual Review of Nuclear Science *(U. S.)*

Annu. Rev. Pharmacol.
*Annual Review of Pharmacology *(U. S.)*

Annu. Rev. Phys. Chem.
*Annual Review of Physical Chemistry *(U. S.)*

Anot. Pediat. (Medellin, Colombia)
*Anotaciones Pediatricas (Medellin, Colombia) *(Colombia)*

An. Real Acad. Nacl. Med. (Madrid)
*Anales de la Real Academia Nacional de Medicina (Madrid) *(Spain)*

An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A
*Anales de la Real Sociedad Espanola de Fisica y Quimica (Madrid), Serie A *(Spain)*

An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. B
*Anales de la Real Sociedad Espanola de Fisica y Quimica (Madrid), Serie B *(Spain)*

An. Soc. Cient. Argent.
*Anales de la Sociedad Cientifica Argentina *(Argentina)*

Antonie van Leeuwenhoek, J. Microbiol. Serol.
Antonie van Leeuwenhoek, Journal of Microbiology and Serology *(Netherlands)*

APCA (Air Pollut. Contr. Ass.) Abstr.
*APCA (Air Pollution Control Association) Abstracts *(U. S.)*

APL (Appl. Phys. Lab.) Tech. Dig.
APL (Applied Physics Laboratory) Technical Digest *(U. S.)*

Appl. Microbiol.
*Applied Microbiology *(U. S.)*

Appl. Opt.
*Applied Optics *(U. S.)*

Appl. Phys. Lett.
*Applied Physics Letters *(U. S.)*

Appl. Sci. Res., Sect. A
*Applied Scientific Research, Section A *(Netherlands)*

Appl. Sci. Res., Sect. B
*Applied Scientific Research, Section B *(Netherlands)*

Appl. Spectros.
*Applied Spectroscopy *(U. S.)*

Arbok Univ. Bergen, Mat.-Natur. Ser.
*Arbok for Universitetet i Bergen, Matematikk-Naturvitenskap Serie *(Norway)*

Arch. Anat. Microscop. Morphol. Exp.
*Archives d'Anatomie Microscopique et de Morphologie Experimentale *(France)*

Arch. Automat. Telemech.
*Archiwum Automatyki i Telemechaniki *(Poland)*

Arch. Belg. Dermatol. Syphiligr.
Archives Belges de Dermatologie et de Syphiligraphie *(Belgium)*

Arch. Biochem. Biophys.
*Archives of Biochemistry and Biophysics *(U. S.)*

Arch. Biol. (Liege)
*Archives de Biologie (Liege) *(Belgium)*

Arch. Bioquim., Quim. Farm. Tucuman
*Archivos de Bioquimica, Quimica y Farmacia, Tucuman *(Argentina)*

Arch. Bodowy Maszyn
*Archiwum Bodowy Maszyn *(Poland)*

Arch. Dermatol.
Archives of Dermatology (formerly A.M.A. Archives of Dermatology) *(U. S.)*

Arch. Eisenhuettenw.
Archiv fuer das Eisenhuettenwesen *(Germany)*

Arch. Elektrotech.
*Archiwum Elektrotechniki *(Poland)*

Arch. Elek. Uebertr.
*Archiv der Elektrischen Uebertragung *(Germany)*

Arch. Environ. Health
*Archives of Environmental Health (formerly A.M.A. Archives of Industrial Health) *(U. S.)*

Arch. Exp. Pathol. Pharmakol.
Archiv fuer Experimentelle Pathologie und Pharmakologie, Naunyn-Schmiedebergs *(Germany)*

Arch. Gorn.
*Archiwum Gornictwa *(Poland)*

Arch. Hosp. Univ. (Havana)
*Archivos de Hospitales Universitarios (Havana) (formerly Archivos del Hospital Universitario) *(Cuba)*

Arch. Hosp. Vargas (Caracas)
*Archivos del Hospital Vargas (Caracas) *(Venezuela)*

Arch. Hutn.
*Archiwum Hutnictwa *(Poland)*

Arch. Hyg. Bakteriol.
*Archiv fuer Hygiene und Bakteriologie *(Germany)*

Arch. Immunol. Terap. Dosw.
Archiwum Immunologii i Terapii Doswaidczalnej **see Arch. Immunol. Therap. Exp.**

Arch. Immunol. Therap. Exp.
*Archivum Immunologiae et Therapiae Experimentalis *(Poland)*

Arch. Interamer. Rheum.
*Archives of Interamerican Rheumatology *(Brazil)*

Arch. Internal Med.
Archives of Internal Medicine (formerly A.M.A. Archives of Internal Medicine) *(U. S.)*

Arch. Int. Pharmacodyn.
*Archives Internationales de Pharmacodynamie et de Therapie *(Belgium)*

Arch. Int. Physiol. Biochim.
Archives Internationales de Physiologie et de Biochimie *(Belgium)*

Arch. Ital. Biol.
*Archives Italiennes de Biologie *(Italy)*

Arch. Klin. Chir.
Archiv fuer Klinische Chirurgie, Langenbecks *(Germany)*

Arch. Med. Mex.
*Archivos Medicos Mexicanos *(Mexico)*

Arch. Mikrobiol.
Archiv fuer Mikrobiologie *(Germany)*

Arch. Ohren, Nasen- Kehlkopfheilk.
Archiv fuer Ohren-, Nasen- und Kehlkopfheilkunde, Vereinigt mit Zeitschrift fuer Hals-, Nasen- und Ohrenheilkunde *(Germany)*

Arch. Ophthalmol. (Berlin)
Archiv fuer Ophthalmologie Vereinigt mit Archiv fuer Augenheilkunde, Albrecht von Graefes (Berlin) *(Germany)*

Arch. Otolaryngol.
Archives of Otolaryngology *(U. S.)*

Arch. Pathol.
*Archives of Pathology (formerly A.M.A. Archives of Pathology) *(U. S.)*

Arch. Peru. Patol. Clin. (Lima)
*Archivos Peruanos de Pathologia y Clinica (Lima) *(Peru)*

Arch. Pharm.
Archiv der Pharmazie und Berichte der Deutschen Pharmazeutischen Gesellschaft (includes Mitteilungen der Deutschen Pharmazeutischen Gesellschaft und der Pharmazeutischen Gesellschaft der DDR) *(Germany)*

Arch. Psychiat. Nervenkrankh.
Archiv fuer Psychiatrie und Nervenkrankheiten Vereinigt mit Zeitschrift fuer die Gesamte Neurologie und Psychiatrie *(Germany)*

Arch. Roum. Pathol. Exp. Microbiol.
*Archives Roumaines de Pathologie Experimentale et de Microbiologie *(France)*

Arch. Sci. Med.
Archivio per le Scienze Mediche *(Italy)*

Arch. Sci. Physiol.
Archives des Sciences Physiologiques *(France)*

Arch. Soc. Estud. Clin. Habana
*Archivos de la Sociedad de Estudios Clinicos de la Habana *(Cuba)*

Arch. Tech. Messen
Archiv fuer Technisches Messen und Industrielle Messtechnik *(Germany)*

Arch. Venezol. Patol. Trop. Parasitol. Med.
*Archivos Venezolanos de Patologia Tropical y Parasitologia Medica *(Venezuela)*

Argonne Nat. Lab. Rev.
*Argonne National Laboratory Reviews (supersedes News-Bulletin International (Argonne National Laboratory)) *(U. S.)*
Ark. Fys.
*Arkiv for Fysik *(Sweden)*
Ark. Fys. Seminar Trondheim
*Arkiv for det Fysiske Seminar i Trodheim *(Norway)*
Ark. Geofys.
Arkiv for Geofysik, Utgivet av Kungl. Svenska Vetenskapsakademien *(Sweden)*
Arkh. Patol.
Arkhiv Patologii *(U. S. S. R.)*
Ark. Kemi
Arkiv for Kemi, Utgivet av Kungl. Svenska Vetenskapsakademien *(Sweden)*
Arq. Brasil. Cardiol.
*Arquivos Brasileiros de Cardiologia *(Brazil)*
Arq. I.B.I.T. (Inst. Brasil. Invest. Tuberc.)
*Arquivos do I.B.I.T. (Instituto Brasileiro para Investigacao da Tuberculose) *(Brazil)*
Arq. Mineir. Leprol.
*Arquivos Mineiros de Leprologia *(Brazil)*
Arq. Patol. (Lisbon)
*Arquivos de Patologia (Lisbon) *(Portugal)*
Arq. Tisiol.
*Arquivos de Tisiologia *(Portugal)*
Arthritis Rheum.
*Arthritis and Rheumatism *(U. S.)*
Arzneim.-Forsch.
Arzneimittel-Forschung *(Germany)*
ASLE (Amer. Soc. Lub. Eng.) Trans.
ASLE (American Society of Lubrication Engineers) Transactions *(U. S.)*
Astronaut. Acta
*Astronautica Acta *(Austria)*
Astronaut. Aeronaut.
*Astronautics & Aeronautics (formerly Astronautics and Aerospace Engineering) *(U. S.)*
Astronautyka
*Astronautyka *(Poland)*
Astrophys. J.
*Astrophysical Journal, The *(U. S.)*
Astrophys. J., Suppl. Ser.
*Astrophysical Journal, The, Supplement Series *(U. S.)*
Astrophys. Norv.
*Astrophysica Norvegica *(Norway)*
Ateneo Parmense
*Ateneo Parmense, L' *(Italy)*
At. Energ. (USSR)
*Atomnaya Energiya† *(U.S.S.R.)*
At. Energy Austral.
*Atomic Energy in Australia *(Australia)*
At. Energy Rev.
*Atomic Energy Review *(Austria)*
At. Kozlem.
*Atomki Kozlemenyek (formerly carried under the title: Magyar Tudomanyos Akademia Atommag Kutato Intezete (Debrecen). Kozlemenyek) *(Hungary)*
Atomdokumentation
*Atomdokumentation. Selektiv Litteraturlesta *(Sweden)*
Atomkernenergie
*Atomkernenergie (formerly Atomenergie) *(Germany)*
Atomlight
*Atomlight *(U. S.)*
Atompraxis
*Atompraxis *(Germany)*
Atomtech. Tajek.
*Atomtechnikai Tajekoztato *(Hungary)*
Atomwirtschaft
*Atomwirtschaft, Die *(Germany)*
Atoomenergie Haar Toepass.
*Atoomenergie en Haar Toepassingen (formerly RCN Bulletin) *(Netherlands)*
At. Strom
*Atom und Strom *(Germany)*
Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.
*Atti della Accademia Nazionale dei Lincei. Rendiconti, Classe di Scienze Fisiche, Matematiche e Naturali *(Italy)*
Atti Accad. Sci. Torino: I. Cl. Sci. Fis., Mat. Natur.
*Atti della Accademia delle Scienze di Torino. Part I. Classe Scienze Fisiche, Matematiche e Naturali *(Italy)*
Atti Ass. Genet. Ital.
*Atti Associazone Genetica Italiana *(Italy)*
Atti Seminar. Mat. Fis. Univ. Modena
*Atti del Seminario Matematico e Fisico dell'Universita di Modena *(Italy)*
Atti Soc. Natur. Mat. Modena
*Atti della Societa dei Naturalisti e Matematici di Modena *(Italy)*
Auk
Auk *(U. S.)*
Austral. Ann. Med.
Australasian Annals of Medicine *(Australia)*
Austral. Dent. J.
Australian Dental Journal *(Australia)*
Austral. J. Biol. Sci.
*Australian Journal of Biological Sciences *(Australia)*
Austral. J. Chem.
*Australian Journal of Chemistry *(Australia)*
Austral. J. Exp. Biol. Med. Sci.
Australian Journal of Experimental Biology and Medical Science, The *(Australia)*
Austral. J. Instrum. Technol.
Australian Journal of Instrument Technology *(Australia)*
Austral. J. Phys.
*Australian Journal of Physics *(Australia)*
Austral. J. Sci.
*Australian Journal of Science, The *(Australia)*
Austral. Radiol.
*Australasian Radiology (formerly Journal of the College of Radiologists of Australasia) *(Australia)*
Automatisme
Automatisme *(France)*
Automaz. Automat.
*Automazione e Automatismi *(Italy)*
Azerbaidzh. Khim. Zh.
*Azerbaidzhanskii Khimicheskii Zhurnal *(Azerbaidzhan S.S.R.)*
Battelle Tech. Rev.
*Battelle Technical Review *(U. S.)*
Bauingenieur
Bauingenieur *(Germany)*
Beitr. Pathol. Anat. Allg. Pathol.
*Beitraege zur Pathologischen Anatomie und zur Allgemeinen Pathologie *(Germany)*
Beitr. Plasmaphys.
*Beitraege aus der Plasmaphysik *(Germany)*
Ber. Bunsenges. Physik. Chem.
*Berichte der Bunsengesellschaft fuer Physikalische Chemie (formerly Zeitschrift fuer Elektrochemie) *(Germany)*
Ber. Deut. Bot. Ges.
Berichte der Deutschen Botanischen Gesellschaft *(Germany)*
Ber. Deut. Keram. Ges.
*Berichte der Deutschen Keramischen Gesellschaft e. V. *(Germany)*
Ber. Deut. Ophthalmol. Ges.
Berichte der Deutschen Ophthalmologischen Gesellschaft *(Germany)*
Bibl. Haematol.
Bibliotheca Haematologica, Supplementa ad Acta Haematologica *(Switzerland)*
Biochem. Biophys. Res. Commun.
*Biochemical and Biophysical Research Communications *(U. S.)*
Biochem. Clin.
Biochemical Clinics *(U. S.)*
Biochemistry
*Biochemistry *(U. S.)*
Biochemistry (USSR) (Engl. Transl.)
*Biochemistry (USSR) (English Translation of Biokhimiya) *(U. S.)*
Biochem. J.
*Biochemical Journal *(England)*
Biochem. Pharmacol.
*Biochemical Pharmacology *(England)*
Biochem. Z.
Biochemische Zeitschrift *(Germany)*
Biochim. Biophys. Acta
*Biochimica et Biophysica Acta *(U. S.)*
Biol. Bull.
Biological Bulletin, The *(U. S.)*
Biol. Med. (Paris)
Biologie Medicale (Paris) *(France)*
Biol. Neonatorum
*Biologia Neonatorum *(Switzerland)*
Biol. Plant., Acad. Sci. Bohemoslov.

Biologia Plantarum, Academia Scientiarum Bohemoslovenica *(Czechoslovakia)*

Biophysics (USSR) (Engl. Transl.)
*Biophysics (USSR) (English Translation of Biofizika) *(England)*

Biophysik
*Biophysik *(Germany)*

Biophys. J.
*Biophysical Journal *(U. S.)*

Biophys. J., Suppl.
*Biophysical Journal, Supplement *(U. S.)*

Biophys. Soc. Abstr.
*Biophysical Society Abstracts *(U. S.)*

Biopolymers
Biopolymers (supersedes in part the Journal of Polymer Science) *(U. S.)*

Bios (Mount Vernon, Iowa)
Bios (Mount Vernon, Iowa) *(U. S.)*

Birth Defects, Orig. Article Ser.
Birth Defects, Original Article Series *(U. S.)*

Blood
*Blood. The Journal of Hematology *(U. S.)*

Blut
Blut *(Germany)*

Boei Eisei
*Boei Eisei (National Defense Medical Journal) *(Japan)*

Bol. Asoc. Med. Puerto Rico
*Boletin de la Asociacion Medica de Puerto Rico *(Puerto Rico)*

Bol. Fac. Ing. Agri-Mens. Montevideo
*Boletin de la Facultad de Ingenieria y Agri-Mensura de Montevideo *(Uruguay)*

Bol. Hosp. Oftalmol. Nuestra Senora de la Luz
*Boletin del Hospital Oftalmologico de Nuestra Senora de la Luz *(Mexico)*

Bol. Inst. Estud. Med. Biol. (Mex.)
*Boletin del Instituto de Estudios Medicos y Biologicos *(Mexico)*

Bol. Inst. Mat. Astron. Fis.
*Boletin del Instituto de Matematica Astronomia y Fisica *(Argentina)*

Boll. Ist. Sieroterap. Milan.
*Bollettino dell'Istituto Sieroterapico Milanese *(Italy)*

Bol. Junta Contr. Energ. At. (Peru)
*Boletin de la Junta do Control de Energia Atomica (formerly Boletin de Informaciones de la Junta do Control de Energia Atomica) *(Peru)*

Boll. Soc. Ital. Biol. Sper.
Bollettino della Societa Italiana di Biologia Sperimentale *(Italy)*

Bol. Soc. Cubana Dermatol. Sifilog.
*Boletin de la Sociedad Cubana de Dermatologia y Sifilografia *(Cuba)*

Bol. Soc. Med. Centro Materno "Gral. Maximino Avila Camacho"
*Boletin de la Sociedad Medica del Centro Maternao "Gral. Maximino Avila Camacho" *(Mexico)*

Bol. Trab. Soc. Cir. Buenos Aires
*Boletines y Trabajos; Sociedad de Cirugia de Buenos Aires *(Argentina)*

Bol. Univ. Parana, Fis. Teorica
*Boletim da Universidade do Parana, Fisica Teorica *(Brazil)*

Bot. Bull. Acad. Sinica (Taiwan)
*Botanical Bulletin of Academia Sinica (Taiwan) *(China)*

Bratisl. Lek. Listy
Bratislavske Lekarske Listy *(Czechoslovakia)*

Brauwissenschaft
Brauwissenschaft *(Germany)*

Brennstoff-Chem.
Brennstoff-Chemie *(Germany)*

Brennstoff-Waerme-Kraft
*Brennstoff-Waerme-Kraft *(Germany)*

Brigham Young Univ. Sci. Bull., Biol. Ser.
*Brigham Young University Science Bulletin, Biological Series *(U. S.)*

Bristol Med.-Chir. J.
Bristol Medico-Chirurgical Journal *(England)*

Brit. Chem. Eng.
*British Chemical Engineering *(England)*

Brit. Columbia Med. J.
*British Columbia Medical Journal *(Canada)*

Brit. Dent. J.
British Dental Journal *(England)*

Brit. J. Anaesth.
British Journal of Anaesthesia *(England)*

Brit. J. Appl. Phys.
*British Journal of Applied Physics *(England)*

Brit. J. Cancer
*British Journal of Cancer *(England)*

Brit. J. Clin. Pract.
British Journal of Clinical Practice, incorporating Medicine Illustrated *(England)*

Brit. J. Dermatol.
British Journal of Dermatology *(England)*

Brit. J. Exp. Pathol.
British Journal of Experimental Pathology, The *(England)*

Brit. J. Non-Destructive Testing
British Journal of Non-Destructive Testing *(England)*

Brit. J. Ophthalmol.
British Journal of Ophthalmology *(England)*

Brit. J. Radiol.
*British Journal of Radiology *(England)*

Brit. J. Surg.
British Journal of Surgery, The *(England)*

Brit. J. Urol.
British Journal of Urology, The *(Scotland)*

Brit. Med. Bull.
British Medical Bulletin *(England)*

Brit. Med. J.
British Medical Journal, The *(England)*

Brit. Vet. J.
British Veterinary Journal, The *(England)*

Brit. Weld. J.
British Welding Journal *(England)*

Bul. Inst. Politeh. Iasi
Buletinul Institutului Politehnic din Iasi *(Romania)*

Bull. Acad. Pol. Sci., Ser. Sci. Biol.
*Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Biologiques *(Poland)*

Bull. Acad. Pol. Sci., Ser. Sci. Chim.
*Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Chimiques *(Poland)*

Bull. Acad. Pol. Sci., Ser. Sci. Geol. Geogr.
*Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Geologiques et Geographiques *(Poland)*

Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.
*Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences, Mathematiques, Astronomiques et Physiques *(Poland)*

Bull. Acad. Pol. Sci., Ser. Sci., Tech.
*Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Techniques *(Poland)*

Bull. Acad. Vet. France
Bulletin de l'Academie Veterinaire de France *(France)*

Bull. Ass. Franc. Etude Cancer
Bulletin de l'Association Francaise pour l'Etude du Cancer *(France)*

Bull. Astron. Inst. Czech.
*Bulletin of the Astronomical Institutes of Czechoslovakia *(Czechoslovakia)*

Bull. Atmos. Radioact. (Jap.)
Bulletin of the Atmospheric Radioactivity (Japan) ***see Taiki Hoshano Kansoku Seiseki***

Bull. Biol. France Belg.
Bulletin Biologique de la France et de la Belgique *(France)*

Bull. Boris Kidrich Inst. Nucl. Sci.
*Bulletin of the Boris Kidrich Institute of Nuclear Sciences *(Yugoslavia)*

Bull. Chem. Soc. Jap.
*Bulletin of the Chemical Society of Japan *(Japan)*

Bull. Cl. Sci., Acad. Roy. Belg.
*Bulletin de la Classe des Sciences, Academie Royale de Belgique *(Belgium)*

Bull. Electrotech. Lab. (Tokyo)
Bulletin of the Electrotechnical Laboratory (Tokyo) ***see Denki Shikensho Iho***

Bull. Exp. Biol. Med. (USSR) (Engl. Transl.)
Bulletin of Experimental Biology and Medicine (USSR) (English Translation of Byulleten Eksperimental'noi Biologii i Meditsiny) *(U. S.)*

Bull. Ga. Acad. Sci.
Bulletin of the Georgia Academy of Science *(U. S.)*

Bull. Heart Inst., Jap.
*Bulletin of the Heart Institute, Japan *(Japan)*

Bull. Hosp. Joint Dis.
*Bulletin of the Hospital for Joint Diseases *(U. S.)*

Bull. Inform. Appl. Ind. Radioelem.

*Bulletin d'Information sur les Applications Industrielles des Radioelements. Supplement au Bulletin d'Information de l'A.T.E.N. (Association Technique pour l'Energie Nucleaire) *(France)*

Bull. Inform. Ass. Belge Develop. Pac. Energ. At.
*Bulletin d'Information de l'Association Belge pour le Developpement Pacifique de l'Energie Atomique *(Belgium)*

Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.)
*Bulletin d'Information A.T.E.N. (Association Technique pour l'Energie Nucleaire) *(France)*

Bull. Inform. Sci. Tech. (Paris)
*Bulletin d'Information Scientifique et Technique (Paris) *(France)*

Bull. Inst. Chem., Acad. Sinica
*Bulletin of the Institute of Chemistry, Academia Sinica *(China)*

Bull. Inst. Chem. Res., Kyoto Univ.
*Bulletin of the Institute for Chemical Research, Kyoto University *(Japan)*

Bull. Inst. Nucl. Sci. "Boris Kidrich" (Belgrade)
*Bulletin of the Institute of Nuclear Science "Boris Kidrich" (Belgrade) *(Yugoslavia)*

Bull. Inst. Public Health (Tokyo)
Bulletin of the Institute of Public Health (Tokyo)
see Koshu Eiseiin Kenkyu Hokoku

Bull. Johns Hopkins Hosp.
Bulletin of the Johns Hopkins Hospital *(U. S.)*

Bull. Math. Biophys.
Bulletin of Mathematical Biophysics *(U. S.)*

Bull. Mineral Res. Explor. Inst. Turkey, Foreign Ed.
*Bulletin of the Mineral Research and Exploration Institute of Turkey, Foreign Edition *(Turkey)*

Bull. Nat. Inst. Hyg. Sci. (Tokyo)
Bulletin of National Institute of Hygenic Sciences (Tokyo)
see Eisei Shikensho Hokoku

Bull. N. Y. Acad. Med.
*Bulletin of the New York Academy of Medicine *(U. S.)*

Bull. Rheum. Dis.
*Bulletin on Rheumatic Diseases *(U. S.)*

Bull. Schweiz. Akad. Med. Wiss.
Bulletin der Schweizerischen Akademie der Medizinischen Wissenschaften *(Switzerland)*

Bull. Schweiz. Elektrotech. Ver.
Bulletin des Schweizerischen Elektrotechnischen Vereins *(Switzerland)*

Bull. Seismol. Soc. Amer.
Bulletin of the Seismological Society of America *(U. S.)*

Bull. Soc. Amis Sci. Lett. Poznan, Ser. B
*Bulletin de la Societe des Amis des Sciences et des Lettres de Poznan, Serie B *(Poland)*

Bull. Soc. Chim. Belges
*Bulletin des Societes Chimiques Belges *(Belgium)*

Bull. Soc. Chim. France
*Bulletin de la Societe Chimique de France *(France)*

Bull. Soc. Franc. Ceram.
Bulletin de la Societe Francaise de Ceramique *(France)*

Bull. Soc. Franc. Dermatol. Syphilgr.
Bulletin de la Societe Francaise de Dermatologie et de Syphiligraphie *(France)*

Bull. Soc. Franc. Mineral. Crist.
*Bulletin de la Societe Francaise de Mineralogie et de Cristallographie *(France)*

Bull. Soc. Int. Chir.
Bulletin de la Societe Internationale de Chirurgie *(Belgium)*

Bull. Soc. Roy. Belge Gynecol. Obstet.
*Bulletin de la Societe Royale Belge de Gynecologie et d'Obstetrique *(Belgium)*

Bull. Soc. Roy. Sci. Liege
*Bulletin de la Societe Royale des Sciences de Liege *(Belgium)*

Bull. Soc. Sci. Bretagne
Bulletin de la Societe Scientifique de Bretagne *(France)*

Bull. Tokyo Inst. Technol.
Bulletin of the Tokyo Institute of Technology *(Japan)*

Bull. Tokyo Med. Dent. Univ.
Bulletin of Tokyo Medical and Dental University *(Japan)*

Bunseki Kagaku
*Bunseki Kagaku (Japan Analyst) *(Japan)*

Burma Med. J.
*Burma Medical Journal *(Burma)*

Byull. Eksp. Biol. Med.
*Byulleten Eksperimental'noi Biologii i Meditsiny† *(U.S.S.R.)*

Cah. Phys.
*Cahiers de Physique *(France)*

Calif. Med.
*California Medicine *(U. S.)*

CA, Med. J.
CA, A Medical Journal Published by the American Cancer Society *(U. S.)*

Can. Aeronaut. Space J.
*Canadian Aeronautics and Space Journal *(Canada)*

Can. Cancer Conf.
Canadian Cancer Conference *(Canada)*

Cancer
*Cancer *(U. S.)*

Cancer Chemotherapy Rep.
*Cancer Chemotherapy Reports *(U. S.)*

Cancer Progr.
Cancer Progress *(England)*

Cancer Res.
*Cancer Research *(U. S.)*

Can. Chem. Process.
*Canadian Chemical Processing *(Canada)*

Can. Entomol.
Canadian Entomologist, The *(Canada)*

Can. Geophys. Bull.
*Canadian Geophysical Bulletin *(Canada)*

Can. J. Biochem.
*Canadian Journal of Biochemistry (supersedes in part Canadian Journal of Biochemistry and Physiology) *(Canada)*

Can. J. Chem.
*Canadian Journal of Chemistry *(Canada)*

Can. J. Chem. Eng.
*Canadian Journal of Chemical Engineering (formerly Canadian Journal of Technology) *(Canada)*

Can. J. Comp. Med. Vet. Sci.
Canadian Journal of Comparative Medicine and Veterinary Science *(Canada)*

Can. J. Earth Sci.
*Canadian Journal of Earth Sciences *(Canada)*

Can. J. Genet. Cytol.
*Canadian Journal of Genetics and Cytology *(Canada)*

Can. J. Math.
*Canadian Journal of Mathematics *(Canada)*

Can. J. Med. Technol.
*Canadian Journal of Medical Technology, The *(Canada)*

Can. J. Microbiol.
*Canadian Journal of Microbiology *(Canada)*

Can. J. Phys.
*Canadian Journal of Physics *(Canada)*

Can. J. Physiol. Pharmacol.
*Canadian Journal of Physiology and Pharmacology (supersedes in part Canadian Journal of Biochemistry and Physiology) *(Canada)*

Can. J. Plant Sci.
Canadian Journal of Plant Science *(Canada)*

Can. J. Public Health
*Canadian Journal of Public Health *(Canada)*

Can. J. Zool.
*Canadian Journal of Zoology *(Canada)*

Can. Math. Bull.
*Canadian Mathematical Bulletin *(Canada)*

Can. Med. Ass. J.
*Canadian Medical Association Journal, The *(Canada)*

Can. Met. Quart.
*Canadian Metallurgical Quarterly *(Canada)*

Can. Mineral.
Canadian Mineralogist, The *(Canada)*

Can. Mining J.
*Canadian Mining Journal *(Canada)*

Can. Mining Met. Bull.
Canadian Mining and Metallurgical Bulletin, The *(Canada)*

Can. Nucl. Technol.
*Canadian Nuclear Technology *(Canada)*

Can. Pat. Office Rec.
*Canadian Patent Office Record *(Canada)*

Can. Power Eng.
*Canadian Power Engineer *(Canada)*

Can. Serv. Med. J.
*Canadian Services Medical Journal *(Canada)*

Can. Spectros.
*Canadian Spectroscopy *(Canada)*

Carbon
*Carbon *(England)*

Cardiologia
*Cardiologia *(Switzerland)*

Caryologia
*Caryologia *(Italy)*
Cas. Lek. Cesk.
Casopis Lekaru Ceskych *(Czechslovakia)*
Cereal Chem.
Cereal Chemistry *(U. S.)*
CERN Cour.
*CERN Courier *(Switzerland)*
Cesk. Cas. Fys.
*Ceskoslovensky Casopis pro Fysiku *(Czechoslovakia)*
Cesk. Radiol.
Ceskoslovenska Radiologie (formerly Ceskoslovenska Rentgenologie) *(Czechoslovakia)*
Cesk. Stomatol.
Ceskoslovenska Stomatologie *(Czechoslovakia)*
Chem. Anal. (Warsaw)
*Chemia Analityczna (Warsaw) *(Poland)*
Chem.-Analyst
*Chemist-Analyst, The *(U. S.)*
Chem. Brit.
*Chemistry in Britain *(England)*
Chem. Bull. (Peking)
Chemical Bulletin (Peking)
see Hua Hseuh Tung Pao
Chem. Can.
*Chemistry in Canada *(Canada)*
Chem. Commun.
*Chemical Communications *(England)*
Chem. Eng. (London)
Chemical Engineer, The (London) (included in Transactions of the Institution of Chemical Engineers (London)) *(England)*
Chem. Eng. Progr.
*Chemical Engineering Progress *(U. S.)*
Chem. Eng. Sci.
*Chemical Engineering Science *(U. S.)*
Chem. Ind. (London)
*Chemistry & Industry (London) *(England)*
Chem.-Ing.-Tech.
*Chemie-Ingenieur-Technik *(Germany)*
Chemistry (Taipei)
Chemistry (Taipei)
see Hua Hsueh
Chem. Listy
*Chemicke Listy *(Czechoslovakia)*
Chem. Process Eng.
*Chemical & Process Engineering (including Atomic World) *(England)*
Chem. Prumysl
Chemicky Prumysl *(Czechoslovakia)*
Chem. Rev.
*Chemical Reviews *(U. S.)*
Chem. Stosow., Ser. A.
*Chemia Stosowana, Seria A *(Poland)*
Chem. Stosow., Ser. B
*Chemia Stosowana, Seria B *(Poland)*
Chem. Tech. (Leipzig)
*Chemische Technik, VEB Deutscher Verlag fuer Grundstoffindustrie, Leipzig *(Germany)*
Chem. Zvesti
Chemicke Zvesti *(Czechoslovakia)*
Chim. Anal.
*Chimie Analytique (Paris) *(France)*
Chimia (Aarau)
*Chimia (Aarau) *(Switzerland)*
Chin. J. Phys. (Taiwan)
*Chinese Journal of Physics (Taiwan) *(China)*
Chin. Med. J.
Chinese Medical Journal, The *(China)*
Chromatogr. Rev.
*Chromatographic Reviews *(U. S.)*
Chung Kuo K'o Hsueh
Chung Kuo K'o Hsueh
see Sci. Sinica (Peking)
Cir. Cirujanos
*Cirurgia y Cirujanos *(Mexico)*
Circulation
Circulation *(U. S.)*
Cir. Gienecol. Urol.
*Cirugia, Ginecologia, y Urologia *(Spain)*
Cir. Res.
Circulation Research *(U. S.)*
Clin. Chem.
*Clinical Chemistry *(U. S.)*
Clin. Chim. Acta
*Clinica Chimica Acta *(Netherlands)*
Clin. Obstet. Gynecol.
Clinical Obstetrics and Gynecology *(U. S.)*
Clin. Radiol.
Clinical Radiology *(Scotland)*
Clin. Radiol. (Jap.)
Clinical Radiology (Japan)
see Rinsho Hoshasen
Clin. Sci.
Clinical Science *(England)*
Collect. Czech. Chem. Commun.
*Collection of Czechoslovak Chemical Communications *(Czechoslovakia)*
Comit. Naz. Energ. Nucl., Notiz.
*Comitato Nazionale per l'Energia Nucleare, Notiziario *(Italy)*
Commun. ACM (Ass. Comput. Mach.)
*Communications of the ACM (Association for Computing Machinery) *(U. S.)*
Communist Chin. Sci. Abstr.
*Communist Chinese Scientific Abstracts *(U. S.)*
Commun. Math. Phys.
Communications in Mathematical Physics *(Germany)*
Commun. Pure Appl. Math.
*Communications on Pure and Applied Mathematics *(U. S.)*
Compt. Rend.
*Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences *(France)*
Compt. Rend. Acad. Bulg. Sci.
Comptes Rendus de l'Academie Bulgare des Sciences *(Bulgaria)*
Compt. Rend. Rech. (Inst. Encour. Rech. Sci. Ind. Agr.)
*Comptes Redus de Recherches (Institut pour l'Encouragement de la Recherche Scientifique dans l'Industrie et l'Agriculture) *(Belgium)*
Compt. Rend. Soc. Biol.
*Comptes Rendus des Seances de la Societe de Biologie et de ses Filiales *(France)*
Compt. Rend. Soc. Franc. Gynecol.
*Comptes Rendus de la Societe Francaise de Gynecologie *(France)*
Compt. Rend. Trav. Lab. Carlsberg
Comptes Rendus des Travaux du Laboratoire Carlsberg *(Denmark)*
Concours Med.
Concours Medical *(France)*
Concrete Constr. Eng.
Concrete and Constructional Engineering *(England)*
Conn. Med.
Connecticut Medicine *(U. S.)*
Construction (Paris)
Construction (Paris) *(France)*
Contemp. Phys.
*Contemporary Physics *(England)*
Corros. Anti-Corros.
*Corrosion et Anti-Corrosion *(France)*
Corrosion
*Corrosion *(U. S.)*
Corros. Sci.
*Corrosion Science *(U. S.)*
Croat. Chem. Acta
*Croatica Chemica Acta *(Yugoslavia)*
Crop Sci.
Crop Science *(U. S.)*
Cryobiology
Cryobiology *(U. S.)*
Cryog. Eng. News
*Cryogenic Engineering News *(U. S.)*
Cryogenics
*Cryogenics *(England)*
Curr. Sci. (India)
*Current Science *(India)*
Cytogenetics
*Cytogenetics *(Switzerland)*
Cytologia (Tokyo)
Cytologia (Tokyo) *(Japan)*
Czech. J. Phys.
*Czechoslovak Journal of Physics *(Czechoslovakia)*
Defektoskopiya
*Defektoskopiya *(U.S.S.R.)*
Denki Gakkai Zasshi

Denki Gakkai Zasshi (The Journal of the Institute of Electric Engineers of Japan) *(Japan)*

Denki Kagaku
Denki Kagaku (Journal of the Electrochemical Society of Japan) *(Japan)*

Denki Shikensho Iho
*Denki Shikensho Iho (Bulletin of the Electrotechnical Laboratory (Tokyo)) *(Japan)*

Dent. Progr.
Dental Progress *(U. S.)*

Dermatologica
*Dermatologica *(Switzerland)*

Dermatol. Trop.
Dermatologia Tropica *(U. S.)*

Dermatol. Wochschr.
Dermatologische Wochenschrift *(Germany)*

Deut. Lebensm.-Rundsch.
Deutsche Lebensmittel-Rundschau *(Germany)*

Deut. Med. Wochschr.
Deutsche Medizinische Wochenschrift *(Germany)*

Deut. Stomatol.
Deutsche Stomatologie *(Germany)*

Deut. Zahnaerztl. Z.
Deutsche Zahnaerztliche Zeitschrift *(Germany)*

Deut. Z. Verdau.- Stoffwechselkrankh.
*Deutsche Zeitschrift fuer Verdauungs-und Stoffwechselkrankheiten *(Germany)*

Develop. Biol.
*Developmental Biology *(U. S.)*

Discovery
*Discovery *(England)*

Discuss. Faraday Soc.
*Discussions of the Faraday Society *(England)*

Diss. Abstr.
*Dissertation Abstracts *(U. S.)*

Dokl. Akad. Nauk Arm. SSR
*Doklady Akademii Nauk Armyanskoi SSR *(Armenian S.S.R.)*

Dokl. Akad. Nauk Belorussk. SSR
Doklady Akademii Nauk Belorusskoi SSR *(Belorussian S.S.R.)*

Dokl. Akad. Nauk BSSR
*Doklady Akademii Nauk BSSR (formerly Doklady Akademii Nauk Belorusskoi SSR) *(Belorussian S.S.R.)*

Dokl. Akad. Nauk SSSR
*Doklady Akademii Nauk SSSR† *(U.S.S.R.)*

Dopov. Akad. Nauk Ukr. RSR
*Dopovidi Akademii Nauk Ukrains'koi RSR *(Ukrainian S.S.R.)*

Duodecim
Duodecim *(Finland)*

Earth Planet. Sci. Lett.
*Earth and Planetary Science Letters *(Netherlands)*

East Europe. Sci. Abstr.
*East European Scientific Abstracts *(U. S.)*

Ecology
Ecology *(U. S.)*

Econ. Geol.
*Economic Geology and the Bulletin of the Society of Economic Geologists *(U. S.)*

Eisei Shikensho Hokoku
Eisei Shikensho Hokoku (Bulletin of National Institute of Hygenic Sciences) *(Japan)*

Ekol. Pol., Ser. B
*Ekologia Polska, Seria B *(Poland)*

Eksp. Khir. Anesteziol.
Eksperimental'naya Khirurgia i Anesteziologiya *(U.S.S.R.)*

Elec. Export Rev.
*Electrical Export Review *(England)*

Elec. Rev.
Electrical Review *(England)*

Electricite
*Electricite *(France)*

Electrochem. Technol.
*Electrochemical Technology *(U. S.)*

Electrochim. Acta
*Electrochimica Acta *(U. S.)*

Electroencephalogr. Clin. Neurophysiol.
Electroencephalography and Clinical Neurophysiology *(Canada)*

Electron. Eng.
*Electronic Engineering Incorporating Electronics, Television and Short Wave World *(England)*

Electronics
*Electronics *(U. S.)*

Electron. Ind.
Electronic Industries *(U. S.)*

Electron. Lett.
*Electronics Letters *(England)*

Electron. Power
*Electronics and Power *(England)*

Electron. Rec.
*Electronics Record *(England)*

Electro-Technol. (N. Y.)
Electro-Technology (New York) *(U. S.)*

Elec. World
Electrical World *(U. S.)*

Elektromed. Ihre Grenz.
Elektromedizin und Ihre Grenzgebiete *(Germany)*

Elektrotech. Z. B.
Elektrotechnische Zeitschrift. Ausgabe B *(Germany)*

Endeavour
*Endeavour *(England)*

Endocrinology
*Endocrinology *(U. S.)*

Endokrynol. Pol.
Endokrynologia Polska *(Poland)*

Energ. Atomtech.
*Energia es Atomtechnika *(Hungary)*

Energiewirtsch. Tagesfragen
Energiewirtschaftliche Tagesfragen *(Germany)*

Energ. Nucl. (Madrid)
*Energia Nuclear (Madrid) *(Spain)*

Energ. Nucl. (Milan)
*Energia Nucleare (Milan) *(Italy)*

Energ. Nucl. (Paris)
*Energie Nucleaire (Paris) *(France)*

Energy Int.
*Energy International *(England)*

Engineer
Engineer, The *(England)*

Engineering
Engineering *(England)*

Engl. Abstr. Soviet Bloc Mainland China Tech. J. Ser. I
*English Abstracts of Selected Articles from Soviet Bloc and Mainland China Technical Journals Series I *(U. S.)*

Engl. Abstr. Soviet Bloc Mainland China Tech. J. Ser. II
*English Abstracts of Selected Articles from Soviet Bloc and Mainland China Technical Journals Series II *(U. S.)*

Engl. Abstr. Soviet Bloc Mainland China Tech. J. Ser. III
*English Abstracts of Selected Articles from Soviet Bloc and Mainland China Technical Journals Series III *(U. S.)*

Engl. Abstr. Soviet Bloc Mainland China Tech. J. Ser. IV
*English Abstracts of Selected Articles from Soviet Bloc and Mainland China Technical Journals Series IV *(U. S.)*

Engl. Abstr. Soviet Bloc Mainland China Tech. J. Ser. V
*English Abstracts of Selected Articles from Soviet Bloc and Mainland China Technical Journals Series V *(U. S.)*

Engl. Abstr. Soviet Bloc Mainland China Tech. J. Ser. VI
*English Abstracts of Selected Articles from Soviet Bloc and Mainland China Technical Journals Series VI *(U. S.)*

Eng. Mining J.
Engineering and Mining Journal *(U. S.)*

Entomol. Rev. (USSR) (Engl. Transl.)
Entomological Revue (USSR) (English Translation of Entomologicheskoe Obozrenie) *(U. S.)*

Ergeb. Allgem. Pathol. Pathol. Anat.
*Ergebnisse der Allgemeinen Pathologie und Pathologischen Anatomie *(Germany)*

Ergeb. Chir. Orthopaed.
Ergebnisse der Chirurgie und Orthopaedie *(Germany)*

Euphytica
Euphytica *(Netherlands)*

Euratom Bull.
*Euratom Bulletin (Bulletin of the European Atomic Energy Community) *(Netherlands)*

EuroNuclear
*EuroNuclear *(England)*

Europe. J. Cancer
*European Journal of Cancer *(England)*

Excerpta Med., Sect. XXIII
*Excerpta Medica, Section XXIII *(Netherlands)*

Exp. Cell Res.
*Experimental Cell Research *(U. S.)*

Experientia
*Experientia *(Switzerland)*

Exp. Eye Res.
Experimental Eye Research *(England)*

Exp. Mech.
Experimental Mechanics *(U. S.)*
Exp. Mol. Pathol.
*Experimental and Molecular Pathology *(U. S.)*
Exp. Neurol.
Experimental Neurology *(U. S.)*
Exp. Tech. Phys.
*Experimentelle Technik der Physik *(Germany)*
FAPIG (Tokyo)
FAPIG (Tokyo) *(Japan)*
Federation Proc.
*Federation Proceedings *(U. S.)*
Federation Proc., Transl. Suppl.
*Federation Proceedings, Translation Supplement *(U. S.)*
Filtr. Sep.
Filtration and Separation *(England)*
Finska Kemistsamfundets Medd.
Finska Kemistsamfundets Meddelanden *(Finland)*
Fiz. Atmos. Okeana
Fizika Atmosfery i Okeana *(U.S.S.R.)*
Fiziol. Zh., Akad. Nauk Ukr. RSR
*Fiziologichnii Zhurnal, Akademiya Nauk Ukrains'koi RSR *(Ukrainian S.S.R.)*
Fiz.-Khim. Mekh. Mater.
*Fiziko-Khimicheskaya Mekhanika Materialov *(Ukrainian S.S.R.)*
Fiz. Metal. Metalloved.
*Fizika Metallov i Metallovedeniya, Akademiya Nauk SSSR, Ural'skii Filial† *(U.S.S.R.)*
Fiz. Szemle
*Fizikai Szemle *(Hungary)*
Fluoric Chem.
Fluoric Chemistry
see **Fusso Kagaku**
Folia Biol. (Prague)
*Folia Biologica (Prague) *(Czechoslovakia)*
Folia Biol. (Warsaw)
*Folia Biologica (Warsaw) *(Poland)*
Folia Clin. Int.
*Folia Clinica Internacional *(Spain)*
Folia Endocrinol. Jap.
Folia Endocrinologica Japonica
see **Nippon Naibumpi Gakkai Zasshi**
Folia Haematol. (Frankfurt)
*Folia Haematologica (Frankfurt) *(Germany)*
Folia Haematol. (Leipzig)
Folia Haematologica (Leipzig) *(Germany)*
Folia Med. (Naples)
*Folia Medica (Naples) *(Italy)*
Folia Med. (Plovdiv)
Folia Medica (Plovdiv) *(Bulgaria)*
Folia Morphol.
*Folia Morphologica *(Poland)*
Food Cosmet. Toxicol.
Food and Cosmetics Toxicology *(England)*
Food Irradiat.
*Food Irradiation *(France)*
Food Technol.
Food Technology *(U. S.)*
Forest Sci.
Forest Science *(U. S.)*
Forschungsber. Landes Nordrhein-Westfalen
Forschungsberichte des Landes Nordrhein-Westfalen *(Germany)*
Fortschr. Chem. Forsch.
*Fortschritte der Chemischen Forschung *(Germany)*
Fortschr. Geb. Roentgenstr. Nuklearmed.
*Fortschritte auf dem Gebiete der Roentgenstrahlen und der Nuklearmedizin, Diagnostik, Physik, Biologie, Therapie *(Germany)*
Fortschr. Kiefer- Gesichtschir.
Fortschritte der Kiefer- und Gesichtschirurgie *(Germany)*
Fortschr. Med.
Fortschritte der Medizin *(Germany)*
Fortschr. Phys.
*Fortschritte der Physik *(Germany)*
Fuji Jiho
Fuji Jiho (Fuji Electric Journal) *(Japan)*
Furukawa Denko Jiho
Furukawa Denko Jiho (Furukawa Electric Review) *(Japan)*
Furukawa Elec. Rev.
Furukawa Electric Review, The
see **Furukawa Denko Jiho**

Fusso Kagaku
Fusso Kagaku (Fluoric Chemistry) *(Japan)*
Gac. Ortoped. Traumatol.
*Gaceta Ortopedia y Traumatologia *(Mexico)*
Gamma Field Symp.
Gamma Field Symposia *(Japan)*
Gann
*Gann *(Japan)*
Gan no Rinsho
Gan no Rinsho (Japanese Journal of Cancer Clinics) *(Japan)*
Gazz. Int. Med. Chir.
Gazzetta Internazionale di Medicina e Chirurgia *(Italy)*
Gazz. Med. Sicil.
Gazzetta Medica Siciliana *(Italy)*
Gazz. Sanit.
Gazzetta Sanitaria *(Italy)*
Geburtsh. Frauenheilk.
*Geburtshilfe und Frauenheilkunde *(Germany)*
G.E.C.J. Sci. Tech.
*G. E. C. Journal of Science and Technology *(England)*
G.E.N. (Caracas)
*G.E.N. (Caracas) *(Venezuela)*
Gen. Comp. Endocrinol.
*General and Comparative Endocrinology *(U. S.)*
Genetica
*Genetica *(Netherlands)*
Genetics
*Genetics *(U. S.)*
Genetika
Genetika *(U.S.S.R.)*
Genet. Pol.
*Genetica Polonica *(Poland)*
Genet. Res.
*Genetical Research *(England)*
Genie Chim.
Genie Chimique (Supplement mensuel a Chimie & Industrie) *(France)*
Genie Civil
Genie Civil, Le *(France)*
Genshikaku Kenkyu
Genshikaku Kenkyu *(Japan)*
Genshiryoku Hatsuden
Genshiryoku Hatsuden (Nuclear Power) *(Japan)*
Genshiryoku Kogyo
*Genshiryoku Kogyo (Nuclear Engineering) *(Japan)*
Geochim. Cosmochim. Acta
*Geochimica et Cosmochimica Acta *(England)*
Geofiz. Kozlem.
*Geofizikai Kozlemenyek *(Hungary)*
Geokhimiya
*Geokhimiya† *(U.S.S.R.)*
Geol. Rudn. Mestorozhd.
Geologiya Rudnykh Mestorozhdenii, Akademiya Nauk SSSR *(U.S.S.R.)*
Geol. Soc. Amer., Bull.
Geological Society of America, Bulletin *(U. S.)*
Geomagn. Aeronomiya
*Geomagnetizm i Aeronomiya† *(U.S.S.R.)*
Geomagn. Aeronomy (USSR) (Engl. Transl.)
Geomagnetism and Aeronomy (USSR) (English Translation of Geomagnetizm i Aeronomiya) *(U. S.)*
Geophysics
*Geophysics *(U. S.)*
Geophys. J.
*Geophysical Journal *(England)*
Geophys. Mag. (Tokyo)
Geophysical Magazine (Tokyo) *(Japan)*
Geophys. Space Data Bull.
*Geophysics and Space Data Bulletin *(U. S.)*
Geotektonika
*Geotektonika *(U.S.S.R.)*
Geriatrics
Geriatrics *(U. S.)*
Gerontol. Clin.
*Gerontologia Clinica *(Switzerland)*
Gerontologia
*Gerontologia *(Switzerland)*
Giessereipraxis
Giessereipraxis *(Germany)*
Gig. Sanit.
*Gigiena i Sanitariya *(U. S. S. R.)*
Giho (Res. Develop. Headquart., Jap. Def. Agency)

Giho (Research and Development Headquarters, Japan Defense Agency) *(Japan)*

Ginecol. Obstet. Mex.
*Ginecologia y Obstetricia de Mexico *(Mexico)*

Giorn. Gerontol.
*Giornale di Gerontologia *(Italy)*

Giorn. Ig. Med. Prevent.
Giornale di Igiene e Medicina Preventiva *(Italy)*

Giorn. Ital. Chemioterap.
*Giornale Italiano di Chemioterapia *(Italy)*

Giorn. Ital. Chir.
Giornale Italiano di Chirurgia *(Italy)*

Giorn. Med. Mil.
Giornale di Medicina Militare *(Italy)*

Giorn. Microbiol.
*Gironale di Microbiologia *(Italy)*

Glas. Mat.-Fiz. Astron., Ser. II
*Glasnik Matematicko-Fizicki i Astronomski, Serija II *(Yugoslavia)*

Glass Technol.
Glass Technology *(England)*

GP, J. Amer. Acad. Gen. Pract.
GP, Journal of the American Academy of General Practice *(U. S.)*

Growth
Growth *(U. S.)*

Gunma J. Med. Sci.
Gunma Journal of Medical Sciences, The *(Japan)*

Gut
Gut *(England)*

Guy's Hosp. Rep.
*Guy's Hospital Reports *(England)*

Gynaecologia
Gynaecologia *(Switzerland)*

Health Phys.
*Health Physics *(U. S.-England)*

Heart Bull.
Heart Bulletin, The *(U. S.)*

Heating, Piping Air Conditioning
Heating, Piping and Air Conditioning *(U. S.)*

Helv. Chim. Acta
*Helvetica Chimica Acta *(Switzerland)*

Helv. Chir. Acta
*Helvetica Chirurgica Acta *(Switzerland)*

Helv. Med. Acta
*Helvetica Medica Acta *(Switzerland)*

Helv. Paediat. Acta
*Helvetica Paediatrica Acta *(Switzerland)*

Helv. Phys. Acta
*Helvetica Physica Acta *(Switzerland)*

Helv. Physiol. Pharmacol. Acta
Helvetica Physiologica et Pharmacologica Acta *(Switzerland)*

Hereditas
*Hereditas *(Sweden)*

Heredity
Heredity *(England)*

Hi-hakai Kensa
Hi-hakai Kensa (Journal of N.D.I.) *(Japan)*

Hilgardia
Hilgardia *(U. S.)*

Hindustan Antibiot. Bull.
*Hindustan Antibiotics Bulletin *(India)*

Hinyokika Kiyo
Hinyokika Kiyo (Acta Urological Japonica) *(Japan)*

Hippokrates (Stuttgart)
Hippokrates (Stuttgart) *(Germany)*

Hirosaki Igaku
*Hirosaki Igaku (The Hirosaki Medical Journal) *(Japan)*

Hirosaki Med. J.
Hirosaki Medical Journal, The
see Hirosaki Igaku

Hiroshima Daigaku Igaku Zasshi
*Hiroshima Daigaku Igaku Zasshi (Medical Journal of Hiroshima University) *(Japan)*

Hiroshima Igaku
Hiroshima Igaku (The Journal of the Hiroshima Medical Association) *(Japan)*

Hiroshima J. Med. Sci.
*Hiroshima Journal of Medical Sciences *(Japan)*

Hitachi Hyoron
Hitachi Hyoron (Hitachi Review) *(Japan)*

Hitachi Zosen Tech. Rev.
Hitachi Zosen Technical Review, The
see Hitachi Zosen Giho

Hodowla Rosl., Aklim. Nasien.
Hodowla Roslin, Aklimatyzacja i Nasiennictwo *(Poland)*

Holztechnologie
Holztechnologie *(Germany)*

Hosp. Progr.
Hospital Progress *(U. S.)*

Ho Tsu K'o Hsueh
*Ho Tsu K'o Hsueh (Nuclear Science) *(China)*

Hua Hsueh
Hua Hsueh (Chemistry (Taipei)) *(China)*

Hua Hseuh Tung Pao
*Hua Hseuh Tung Pao (Chemical Bulletin) *(China)*

Huaxue Tongbao
Huaxue Tongbao
see Hua Hseuh Tung Pao

Hung. Tech. Abstr.
*Hungarian Technical Abstracts *(Hungary)*

IBM J. Res. Develop.
IBM Journal of Research and Development *(U. S.)*

Icarus
*Icarus. International Journal of the Solar System *(U. S.–England)*

Ideggyogy. Szemle
Ideggyogyaszati Szemle *(Hungary)*

Idengaku Zasshi
*Idengaku Zasshi (Japanese Journal of Genetics) *(Japan)*

IEEE (Inst. Elec. Electron. Eng.) J. Quantum Electron.
IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics *(U. S.)*

IEEE (Inst. Elec. Electron. Eng.), Spectrum
*IEEE (Institute of Electrical and Electronics Engineers), Spectrum *(U. S.)*

IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Antennas and Propagation (formerly IRE (Institute of Radio Engineers), Transactions on Antennas and Propagation) *(U. S.)*

IEEE (Inst. Elec. Electron. Eng.), Trans. Commun. Technol.
*IEEE (Institute of Electrical and Electronics Engineers), Transactions on Communication Technology (formerly IEEE (Institute of Electrical and Electronics Engineers), Transactions on Communication and Electronics) *(U. S.)*

IEEE (Inst. Elec. Electron. Eng.), Trans. Educ.
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Education *(U. S.)*

IEEE (Inst. Elec. Electron. Eng.), Trans. Ind. Electron. Contr. Instrum.
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Industrial Electronics and Control Instrumentation (formerly IEEE (Institute of Electrical and Electronics Engineers), Transactions on Industrial Electronics) *(U. S.)*

IEEE (Inst. Elec. Electron. Eng.), Trans. Instr. Meas.
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Instrumentation and Measurement (formerly IRE (Institute of Radio Engineers), Transactions on Instrumentation) *(U. S.)*

IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.
*IEEE (Institute of Electrical and Electronics Engineers), Transactions on Nuclear Science (formerly IRE (Institute of Radio Engineers), Transactions on Nuclear Science) *(U. S.)*

IEEE (Inst. Elec. Electron. Eng.), Trans. Parts, Mater. Packaging
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Parts, Materials and Packaging (formed by a merger of IEEE (Institute of Electrical and Electronics Engineers), Transactions on Components Parts, and IEEE (Institute of Electrical and Electronics Engineers), Transactions on Products Engineering and Production) *(U. S.)*

Igiena (Bucharest)
Igiena (Bucharest) *(Romania)*

Immunology
*Immunology *(England)*

Ind. At.
*Industries Atomiques *(France)*

Ind. Chim. Belge
Industrie Chimique Belge *(Belgium)*

Ind. Eng. Chem.
*Industrial and Engineering Chemistry *(U. S.)*

Ind. Eng. Chem., Fundament.
*Industrial & Engineering Chemistry, Fundamentals *(U. S.)*

Ind. Eng. Chem., Process Design Develop.
*Industrial & Engineering Chemistry, Process Design and Development *(U. S.)*

Ind. Eng. Chem., Prod. Res. Develop.
*Industrial & Engineering Chemistry, Product Research and Development *(U. S.)*

Indian Concrete J.
Indian Concrete Journal *(India)*

Indian East. Eng.
*Indian & Eastern Engineer, The (incorporating the Far Eastern Engineer and Indian & Eastern Motors) *(India)*

Indian J. Biochem.
Indian Journal of Biochemistry *(India)*

Indian J. Cancer
Indian Journal of Cancer *(India)*

Indian J. Chem.
*Indian Journal of Chemistry *(India)*

Indian J. Child Health
*Indian Journal of Child Health, The *(India)*

Indian J. Exp. Biol.
*Indian Journal of Experimental Biology *(India)*

Indian J. Med. Sci.
*Indian Journal of Medical Sciences *(India)*

Indian J. Pharm.
Indian Journal of Pharmacy, The *(India)*

Indian J. Phys.
*Indian Journal of Physics and Proceedings of the Indian Association for the Cultivation of Science *(India)*

Indian J. Pure Appl. Phys.
*Indian Journal of Pure & Applied Physics *(India)*

Indian J. Radiol.
*Indian Journal of Radiology *(India)*

Indian J. Technol.
*Indian Journal of Technology (formerly Journal of Scientific and Industrial Research (India), Section D) *(India)*

Indian Sci. Abstr.
*Indian Science Abstracts *(India)*

Ind. Med. Surg.
*Industrial Medicine and Surgery *(U. S.)*

Ind. Res.
*Industrial Research *(U. S.)*

Inform. Quim. Anal. (Madrid)
Informacion de Quimica Analitica (Madrid) *(Spain)*

Ing. Nucl.
*Ingegneria Nucleare *(Italy)*

Inorg. Chem.
*Inorganic Chemistry *(U. S.)*

Inorg. Nucl. Chem. Lett.
*Inorganic and Nuclear Chemistry Letters *(England–U. S.)*

Instrum. Nucl. (Paris)
*Instrumentation Nucleaire (Paris). Supplement au Bulletin d'Informations Scientifiques et Techniques (Paris) *(France)*

Instrum. Pract.
Instrument Practice *(England)*

Int. Aerospace Abstr.
*International Aerospace Abstracts *(U. S.)*

Int. Arch. Allergy Appl. Immunol.
*International Archives of Allergy and Applied Immunology *(Switzerland)*

Int. At. Energy Agency Bull.
*International Atomic Energy Agency Bulletin *(Austria)*

Int. Dent. J.
International Dental Journal *(Netherlands)*

Internist
Internist, Der *(Germany)*

Int. J. Air Water Pollut.
*International Journal of Air & Water Pollution (formerly International Journal of Air Pollution) *(England)*

Int. J. Appl. Radiat. Isotop.
*International Journal of Applied Radiation and Isotopes *(England)*

Int. J. Cancer
*International Journal of Cancer *(Denmark)*

Int. J. Electron.
*International Journal of Electronics (formerly Journal of Electronics and Control) *(England)*

Int. J. Eng. Sci.
International Journal of Engineering Science *(England)*

Int. J. Heat Mass Transfer
*International Journal of Heat and Mass Transfer *(England)*

Int. J. Powder Met.
*International Journal of Powder Metallurgy *(U. S.)*

Int. J. Radiat. Biol.
*International Journal of Radiation Biology and related studies in Physics, Chemistry and Medicine *(England)*

Int. Rev. Cytol.
International Review of Cytology *(U. S.)*

Int. Sci. Technol.
*International Science and Technology *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. I
*International Series of Monographs on Nuclear Energy, Division I. Economics and Law *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. II
*International Series of Monographs on Nuclear Energy, Division II. Nuclear Physics *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. III
*International Series of Monographs on Nuclear Energy, Division III. Biology *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. IV
*International Series of Monographs on Nuclear Energy, Division IV. Isotopes and Radiation *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. V
*International Series of Monographs on Nuclear Energy, Division V. Health Physics *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. VI
*International Series of Monographs on Nuclear Energy, Division VI. Medicine *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. VII
*International Series of Monographs on Nuclear Energy, Division VII. Reactor Engineering *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. VIII
*International Series of Monographs on Nuclear Energy, Division VIII. Materials *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. IX
*International Series of Monographs on Nuclear Energy, Division IX. Chemical Engineering *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. X
*International Series of Monographs on Nuclear Energy, Division X. Reactor Design Physics *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. XI
*International Series of Monographs on Nuclear Energy, Division XI. Reactor Operational Problems *(U. S.)*

Int. Ser. Monogr. Nucl. Energy, Div. XIV
*International Series of Monographs on Nuclear Energy, Division XIV. Plasma Physics and Thermonuclear Research *(U. S.)*

Int. Z. Vitaminforsch.
Internationale Zeitschrift fuer Vitaminforschung *(Switzerland)*

Invest. Ophthalmol.
Investigative Ophthalmology *(U. S.)*

Invest. Radiol.
*Investigative Radiology *(U. S.)*

Invest. Urol.
Investigative Urology *(U. S.)*

Inzh.-Fiz. Zh.
*Inzhenerno-Fizicheskii Zhurnal (formerly Inzhenerno-Fizicheskii Zhurnal, Akademii Nauk Belorusskoi SSR) *(Belorussian S.S.R.)*

ISA (Instrum. Soc. Amer.) Trans.
*ISA (Instrument Society of America) Transactions *(U. S.)*

Isotopenpraxis
*Isotopenpraxis *(Germany)*

Isotop. Radiat. Technol.
*Isotopes and Radiation Technology (A Quarterly Technical Progress Review) *(U. S.)*

Israel J. Chem.
*Israel Journal of Chemistry (supersedes Bulletin of the Research Council of Israel, Section A: Chemistry) *(Israel)*

Israel J. Exp. Med.
Israel Journal of Experimental Medicine (formerly Bulletin of the Research Council of Israel, Section E) *(Israel)*

Israel J. Med. Sci.
Israel Journal of Medical Sciences (formed by a merger of Israel Medical Journal and Israel Journal of Experimental Medicine) *(Israel)*

Israel J. Phys.
*Israel Journal of Physics (supersedes in part Bulletin of the Research Council of Israel, Section F: Mathematics and Physics) *(Israel)*

Issled. Fiz. Atmos., Akad. Nauk Est. SSR
*Issledovaniya po Fizike Atmosfery, Akademiya Nauk Estonskoi SSR *(Estonian S.S.R.)*

Issled. Zharoproch. Splavam, Akad. Nauk SSSR, Inst. Met.
*Issledovaniya po Zharoprochnym Splavam, Akademiya Nauk

SSSR, Institut Metallurgii imeni A. A. Baikova *(U.S.S.R.)*

Istanbul Tek. Univ. Bul.
*Istanbul Teknik Universitesi Bulteni *(Turkey)*

Istanbul Univ. Fen Fak. Mecmuasi, Seri A
*Istanbul Universitesi Fen Fakultesi Mecmuasi, Seri A *(Turkey)*

Istanbul Univ., Fen Fak. Mecmuasi, Seri C
*Istanbul Universitesi Fen Fakultesi Mecmuasi: Seri C: Astronomi-Fizik-Kimya *(Turkey)*

Izmeritel. Tekh.
*Izmeritel'naya Tekhnika† *(U.S.S.R.)*

Izv. Akad. Nauk Arm. SSR, Nauk Zemle
*Izvestiya Akademii Nauk Armyanskoi SSR, Nauk o Zemle *(Armenian S.S.R.)*

Izv. Akad. Nauk Arm. SSR, Ser. Fiz. Mat. Nauk
*Izvestiya Akademii Nauk Armyanskoi SSR, Seriya Fiziko-Matematicheskikh Nauk *(Armenian S.S.R.)*

Izv. Akad. Nauk Azerbaidzh. SSR, Ser. Fiz.-Tekh. Mat. Nauk
*Izvestiya Akademii Nauk Azerbaidzhanskoi SSR, Seriya Fiziko-Tekhnicheskikh i Matematicheskikh Nauk (formerly Izvestiya Akademii Nauk Azerbaidzhanskoi SSR, Seriya Fiziko-Matematicheskikh i Tekhnicheskikh Nauk) *(Azerbaidzhan S.S.R.)*

Izv. Akad. Nauk Est. SSR, Ser. Biol.
*Izvestiya Akademii Nauk Estonskoi SSR, Seriya Biologicheskaya *(Estonian S.S.R.)*

Izv. Akad. Nauk Est. SSR, Ser. Fiz. Mat. Tekh. Nauk
*Izvestiya Akademii Nauk Estonskoi SSR, Seriya Fiziko-Matematicheskikh i Tekhnicheskikh Nauk (formerly Izvestiya Akademii Nauk Estonskoi SSR, Seriya Tekhnicheskikh i Fiziko Matematicheskikh Nauk) *(Estonian S.S.R.)*

Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat. Nauk
*Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Fiziko-Matematicheskikh Nauk *(Kazakh S.S.R.)*

Izv. Akad. Nauk SSSR, Energ. Transp.
*Izvestiya Akademii Nauk SSSR, Energetika i Transport (formerly Izvestiya Akademii Nauk SSSR, Otdelenie Tekhnicheskikh Nauk, Energetika i Transport) *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana
*Izvestiya Akademii Nauk SSSR, Fizika Atmosfery i Okeana (supersedes in part Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskiya) *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Fiz. Zemli
*Izvestiya Akademii Nauk SSSR, Fizika Zemli (supersedes in part Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskiya) *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Mekh.
*Izvestiya Akademii Nauk SSSR, Mekhanika (formerly Izvestiya Akademii Nauk SSSR, Mekhanika i Mashinostroenie) *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Mekh. Zhidkosti Gaza
*Izvestiya Akademii Nauk SSSR, Mekhanika Zhidkosti i Gaza *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Metal.
*Izvestiya Akademii Nauk SSSR, Metally (formerly Izvestiya Akademii Nauk SSSR, Metallurgiya i Gornoe Delo) *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Neorg. Mater.
Izvestiya Akademii Nauk SSSR, Neorganicheskie Materialy *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Ser. Biol.
*Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Ser. Fiz.
*Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya† *(U.S.S.R.)*

Izv. Akad. Nauk SSSR, Ser. Khim.
*Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya (formerly Izvestiya Akademii Nauk SSSR, Otdelenie Khimicheskikh Nauk) *(U.S.S.R.)*

Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk
*Izvestiya Akademii Nauk Uzbekskoi SSR, Seriya Fiziko-Matematicheskikh Nauk *(Uzbek S.S.R.)*

Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.
*Izvestiya na Fizicheskiya Institut s Aneb, Bulgarska Akademiya na Naukite *(Bulgaria)*

Izv. Sibirsk. Otd. Akad. Nauk SSSR
*Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR *(U.S.S.R.)*

Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Biol.-Med. Nauk
*Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Biologo-Meditsinskikh Nauk *(U.S.S.R.)*

Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk
*Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Khimicheskikh Nauk *(U.S.S.R.)*

Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk
*Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Tekhnicheskikh Nauk (supersedes in part Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR) *(U.S.S.R.)*

Izv. Vyssh. Uchob. Zaved., Chem. Met.
Izvestiya Vysshikh Uchebnykh Zavedenii, Chernaya Metallurgiya *(U.S.S.R.)*

Izv. Vyssh. Uchob. Zaved., Fiz.
*Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika *(U.S.S.R.)*

Izv. Vyssh. Uchob. Zaved., Khim. Khim. Tekhnol.
Izvestiya Vysshikh Uchebnykh Zavedenii, Khimiya i Khimicheskaya Tekhnologiya *(U.S.S.R.)*

Izv. Vyssh. Uchob. Zaved., Mat.
*Izvestiya Vysshikh Uchebnykh Zavedenii, Matematika *(U.S.S.R.)*

Izv. Vyssh. Uchob. Zaved., Radiofiz.
*Izvestiya Vysshikh Uchebnykh Zavednii, Radiofizika† *(U.S.S.R.)*

Izv. Vyssh. Uchob. Zaved., Tsvetn. Met.
*Izvestiya Vysshikh Uchebnykh Zavednii, Tsvetnaya Metallurgiya *(U.S.S.R.)*

Jad. Energ.
*Jaderna Energie *(Czechoslovakia)*

J. Agr. Chem. Soc. Jap.
Journal of the Agricultural Chemical Society of Japan
see Nippon Nogeikagaku Kaishi

J. Agr. Food Chem.
Journal of Agricultural and Food Chemistry *(U. S.)*

Jahresber. Deut. Wetterdienstes
*Jahresberichte des Deutschen Wetterdienstes *(Germany)*

J. Amer. Ceram. Soc.
*Journal of the American Ceramic Society *(U. S.)*

J. Amer. Chem. Soc.
*Journal of the American Chemical Society *(U. S.)*

J. Amer. Dent. Ass.
Journal of the American Dental Association, The *(U. S.)*

J. Amer. Med. Ass.
Journal of the American Medical Association, The *(U. S.)*

J. Amer. Osteopath. Ass.
Journal of the American Osteopathic Association, The *(U. S.)*

J. Amer. Pharm. Ass.
Journal of the American Pharmaceutical Association *(U. S.)*

J. Amer. Vet. Med. Ass.
Journal of the American Veterinary Medical Association *(U. S.)*

J. Amer. Water Works Ass.
*Journal of the American Water Works Association *(U. S.)*

J. Animal Sci.
Journal of Animal Science *(U. S.)*

Jap. Anal.
Japan Analyst
see Bunseki Kagaku

Jap. Cir. J. (Engl. Ed.)
*Japanese Circulation Journal (English Edition) *(Japan)*

Jap. Heart J.
*Japanese Heart Journal *(Japan)*

Jap. J. Appl. Phys.
*Japanese Journal of Applied Physics *(Japan)*

Jap. J. Cancer Clin.
Japanese Journal of Cancer Clinics
see Gan no Rinsho

Jap. J. Exp. Med.
Japanese Journal of Experimental Medicine *(Japan)*

Jap. J. Genet.
Japanese Journal of Genetics
see Idengaku Zasshi

Jap. J. Tuberc.
Japanese Journal of Tuberculosis, The *(Japan)*

Jap. J. Zool.
Japanese Journal of Zoology *(Japan)*

J. Appl. Bacteriol.
Journal of Applied Bacteriology, The *(England)*

J. Appl. Chem. (London)
*Journal of Applied Chemistry (London) *(England)*

J. Appl. Mech.
*Journal of Applied Mechanics, Transactions of the ASME, Series E *(U. S.)*

J. Appl. Meteorol.
*Journal of Applied Meteorology *(U. S.)*

J. Appl. Phys.
*Journal of Applied Physics *(U. S.)*

J. Appl. Physiol.
Journal of Applied Physiology *(U. S.)*

J. Appl. Polymer Sci.
*Journal of Applied Polymer Science *(U. S.)*
J. Arkansas Med. Soc.
Journal of the Arkansas Medical Society, The *(U. S.)*
J. Ass. Offic. Agr. Chem.
*Journal of the Association of Official Agricultural Chemists *(U. S.)*
J. At. Energy Soc. Jap.
Journal of the Atomic Energy Society of Japan
see Nippon Genshiryoku Gakkaishi
J. Atmos. Sci.
*Journal of the Atmospheric Sciences (formerly the Journal of Meteorology) *(U. S.)*
J. Atmos. Terrest. Phys.
*Journal of Atmospheric and Terrestrial Physics *(U. S.)*
J. Austral. Inst. Metals
*Journal of the Australian Institute of Metals *(Australia)*
J. Bacteriol.
*Journal of Bacteriology *(U. S.)*
J. Basic Eng.
*Journal of Basic Engineering, Transactions of the ASME, Series D *(U. S.)*
J. Belge Radiol.
*Journal Belge de Radiologie *(Belgium)*
J. Biol. Chem.
*Journal of Biological Chemistry, The *(U. S.)*
J. Bone Joint Surg.
Journal of Bone and Joint Surgery, The *(U. S.)*
J. Brasil. Neurol.
*Journal Brasileiro de Neurologia *(Brazil)*
J. Brasil. Psiquiat.
*Journal Brasileiro de Psiquiatria *(Brazil)*
J. Brit. Interplanet. Soc.
*Journal of the British Interplanetary Society *(England)*
J. Brit. Nucl. Energy Soc.
*Journal of the British Nuclear Energy Society, The (formerly Journal of the British Nuclear Energy Conference) *(England)*
J. Calif. State Dent. Ass.
Journal of the California State Dental Association, The *(U. S.)*
J. Can. Ass. Radiol.
*Journal of the Canadian Association of Radiologists *(Canada)*
J. Can. Ceram. Soc.
*Journal of the Canadian Ceramic Society *(Canada)*
J. Can. Dent. Ass.
Journal of the Canadian Dental Association, The *(Canada)*
J. Catalysis
Journal of Catalysis *(U. S.)*
J. Cell Biol.
Journal of Cell Biology, The (formerly Journal of Biophysical and Biochemical Cytology) *(U. S.)*
J. Cell. Comp. Physiol.
*Journal of Cellular and Comparative Physiology *(U. S.)*
J. Chem. Educ.
Journal of Chemical Education *(U. S.)*
J. Chem. Eng. Data
*Journal of Chemical and Engineering Data *(U. S.)*
J. Chem. Phys.
*Journal of Chemical Physics, The *(U. S.)*
J. Chem. Soc.
*Journal of the Chemical Society (London) *(England)*
J. Chem. Soc. Jap.
Journal of the Chemical Society of Japan
see Nippon Kagaku Zasshi
J. Chem. Soc. Jap., Pure Chem. Sect.
Journal of the Chemistry Society of Japan, Pure Chemistry Section
see Nippon Kagaku Zasshi
J. Chem. UAR
Journal of Chemistry of the UAR *(Egypt)*
J. Chim. Phys.
*Journal de Chimie Physique et de Physicochimie Biologique *(France)*
J. Chin. Chem. Soc. (Taiwan)
*Journal of the Chinese Chemical Society (Taiwan) *(China)*
J. Chromatog.
*Journal of Chromatography *(Netherlands)*
J. Clin. Endocrinol. Metab.
*Journal of Clinical Endocrinology and Metabolism, The *(U. S.)*
J. Clin. Invest.
*Journal of Clinical Investigation, The *(U. S.)*
J. Coll. Radiol. Austral.
Journal of the College of Radiologists of Australasia *(Australia)*
J. Dairy Sci.
Journal of Dairy Science *(U. S.)*
J. Dent. Children
Journal of Dentistry for Children *(U. S.)*
J. Dent. Res.
Journal of Dental Research, The *(U. S.)*
J. Econ. Entomol.
Journal of Economic Entomology *(U. S.)*
J. Egypt. Med. Ass.
*Journal of the Egyptian Medical Association, The *(Egypt)*
J. Electroanal. Chem.
*Journal of Electroanalytical Chemistry *(Netherlands)*
J. Electrochem. Soc.
*Journal of the Electrochemical Society *(U. S.)*
J. Embryol. Exp. Morphol.
*Journal of Embryology and Experimental Morphology *(England)*
J. Endocrinol.
Journal of Endocrinology, The *(England)*
J. Eng. Educ.
Journal of Engineering Education *(U. S.)*
J. Eng. Power
*Journal of Engineering for Power, Transactions of the ASME, Series A *(U. S.)*
J. Environ. Sci.
Journal of Environmental Sciences *(U. S.)*
JETP Lett. (USSR) (Engl. Transl.)
*JETP Letters (USSR) (English Translation of Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki, Pis'ma v Redaktsiyu) *(U. S.)*
J. Exp. Med.
*Journal of Experimental Medicine *(U. S.)*
J. Exp. Zool.
Journal of Experimental Zoology *(U. S.)*
J. Fluid Mech.
*Journal of Fluid Mechanics *(U. S.)*
J. Food Sci.
Journal of Food Science (formerly Food Research) *(U. S.)*
J. Franklin Inst.
Journal of the Franklin Institute *(U. S.)*
J. Genet.
*Journal of Genetics *(U. S.)*
J. Genet. Psychol.
Journal of Genetic Psychology, The *(U. S.)*
J. Gen. Microbiol.
Journal of General Microbiology *(England)*
J. Gen. Physiol.
Journal of General Physiology *(U. S.)*
J. Geomagnet. Geoelec.
*Journal of Geomagnetism and Geoelectricity *(Japan)*
J. Geophys. Res.
*Journal of Geophysical Research *(U. S.)*
J. Gerontol.
*Journal of Gerontology *(U. S.)*
J. Heat Transfer
*Journal of Heat Transfer, Transactions of the ASME, Series C *(U. S.)*
J. Heredity
Journal of Heredity *(U. S.)*
J. Heterocycl. Chem.
Journal of Heterocyclic Chemistry *(U. S.)*
J. Histochem. Cytochem.
Journal of Histochemistry and Cytochemistry, The *(U. S.)*
Jikeikai Med. J.
*Jikeikai Medical Journal *(Japan)*
J. Immunol.
*Journal of Immunology, The *(U. S.)*
J. Indian Chem. Soc.
*Journal of the Indian Chemical Society *(India)*
J. Indian Inst. Sci.
*Journal of the Indian Institute of Science *(India)*
J. Infect. Dis.
Journal of Infectious Diseases, The *(U. S.)*
J. Inorg. Nucl. Chem.
*Journal of Inorganic & Nuclear Chemistry *(England)*
J. Inst. Elec. Eng. Jap.
Journal of the Institute of Electric Engineers of Japan, The
see Denki Gakkai Zasshi
J. Inst. Eng., Austral.
*Journal of the Institution of Engineers, Australia *(Australia)*
J. Inst. Math. Appl.
*Journal of the Institute of Mathematics and Its Applications

(England)

J. Inst. Metals
*Journal of the Institute of Metals with Bulletin and Metallurgical Abstracts *(England)*

J. Inst. Water Eng.
Journal of the Institution of Water Engineers *(England)*

J. Int. Coll. Surg.
Journal of the International College of Surgeons, The *(U. S.)*

J. Invest. Dermatol.
Journal of Investigative Dermatology, The *(U. S.)*

J. Jap. Inst. Metals (Sendai)
Journal of the Japan Institute of Metals (Sendai)
*see **Nippon Kinzoku Gakkaishi***

J. Jap. Soc. Lub. Eng.
Journal of Japan Society of Lubrication Engineers
*see **Junkatsu***

J. Joint Panel Nucl. Marine Propul.
*Journal of the Joint Panel on Nuclear Marine Propulsion *(England)*

J. Kans. Med. Soc.
Journal of the Kansas Medical Society, The *(U. S.)*

J. Korean Chem. Soc.
Journal of the Korean Chemical Society
*see **Ta Han Hua Hsueh Hui-Chih***

J. Kumamoto Med. Soc.
Journal of the Kumamoto Medical Society, The
*see **Kumamoto Igakkai Zasshi***

J. Lab. Clin. Med.
*Journal of Laboratory and Clinical Medicine, The *(U. S.)*

J. Label. Compounds
*Journal of Labelled Compounds *(Belgium)*

J. Lancet
Journal-Lancet, The *(U. S.)*

J. La. State Med. Soc.
Journal of the Louisiana State Medical Society *(U. S.)*

J. Less-Common Metals
*Journal of the Less-Common Metals *(Netherlands)*

J. Lipid Res.
Journal of Lipid Research *(U. S.)*

J. Math. Anal. Appl.
*Journal of Mathematical Analysis and Applications *(U. S.)*

J. Math. Phys. (N. Y.)
*Journal of Mathematical Physics (New York) *(U. S.)*

J. Mecan.
*Journal de Mecanique *(France)*

J. Mech. Eng. Sci.
Journal of Mechanical Engineering Science, The *(England)*

J. Mech. Lab. Jap.
Journal of the Mechanical Laboratory of Japan *(Japan)*

J. Med. Chem.
Journal of Medicinal Chemistry *(U. S.)*

J. Metals
*Journal of Metals *(U. S.)*

J. Meteorol.
*Journal of Meteorology, The *(U. S.)*

J. Microscop.
Journal de Microscopie *(France)*

J. Milk Food Technol.
Journal of Milk and Food Technology *(U. S.)*

J. Mississippi State Med. Ass.
Journal of the Mississippi State Medical Association *(U. S.)*

J. Mol. Biol.
*Journal of Molecular Biology *(England)*

J. Mol. Spectros.
*Journal of Molecular Spectroscopy *(U. S.)*

J. Mount Sinai Hosp., N. Y.
Journal of the Mount Sinai Hospital, New York *(U. S.)*

J. Nagasaki Med. Ass.
Journal of the Nagasaki Medical Association
*see **Nagasaki Igakkai Zasshi***

J. Nat. Cancer Inst.
*Journal of the National Cancer Institute *(U. S.)*

J. Nat. Med. Ass.
Journal of the National Medical Association *(U. S.)*

J. Nat. Res. Counc. Thailand
*Journal of the National Research Council of Thailand (contains Part I. Natural Science and Part II. Social Science, paged separately) *(Thailand)*

J. Natur. Sci. Math.
*Journal of Natural Sciences and Mathematics *(Pakistan)*

J. N. D. I. (Jap.)
Journal of N. D. I. (Japan)
*see **Hi-hakai Kensa***

J. Neurosurg.
Journal of Neurosurgery *(U. S.)*

J. New Zeal. Inst. Chem.
Journal of the New Zealand Institute of Chemistry *(New Zealand)*

J. Nucl. Energy: Pt. A & B
*Journal of Nuclear Energy: Parts A & B. Reactor Science and Technology (formerly issued separately) *(England)*

J. Nucl. Energy: Pt. C
*Journal of Nuclear Energy: Part C. Plasma Physics–Accelerators–Thermonuclear Research *(England)*

J. Nucl. Mater.
*Journal of Nuclear Materials (Journal des Materiaux Nucleaires) *(Netherlands)*

J. Nucl. Med.
*Journal of Nuclear Medicine *(U. S.)*

J. Nucl. Sci. Technol. (Tokyo)
*Journal of Nuclear Science and Technology (Tokyo) *(Japan)*

J. Nutr.
Journal of Nutrition, The *(U. S.)*

J. Obstet. Gynaecol. Brit. Commonwealth
Journal of Obstetrics and Gynaecology of the British Commonwealth *(England)*

J. Okayama Med. Soc.
Journal of Okayama Medical Society
*see **Okayama Igakkai Zasshi***

J. Opt. Soc. Amer.
*Journal of the Optical Society of America *(U. S.)*

J. Org. Chem.
*Journal of Organic Chemistry, The *(U. S.)*

J. Osaka City Med. Cent.
Journal of the Osaka City Medical Center, The
*see **Osaka Shiritsu Daigaku Igaku Zasshi***

J. Pediat.
Journal of Pediatrics, The *(U. S.)*

J. Periodontol.
Journal of Periodontology, The *(U. S.)*

J. Petrol.
Journal of Petrology *(England)*

J. Petrol. Technol.
Journal of Petroleum Technology *(U. S.)*

J. Pharm. Belg.
Journal de Pharmacie de Belgique *(Belgium)*

J. Pharm. Sci.
Journal of Pharmaceutical Sciences *(U. S.)*

J. Pharm. Soc. Jap.
Journal of the Pharmaceutical Society of Japan
*see **Yakugaku Zasshi***

J. Phys. (Paris)
*Journal de Physique (Paris) (formerly Le Journal de Physique et le Radium) *(France)*

J. Phys. Chem.
*Journal of Physical Chemistry, The *(U. S.)*

J. Phys. Chem. Solids
*Journal of Physics and Chemistry of Solids (formerly Physics and Chemistry of Solids, The) *(U. S.)*

J. Physiol. (Paris)
Journal de Physiologie (Paris) *(France)*

J. Phys., Phys. Appl. (Paris)
*Journal de Physique, Physique Applique (Paris). Supplement au Journal de Physique (Paris) *(France)*

J. Phys. Soc. Jap.
*Journal of the Physical Society of Japan *(Japan)*

J. Polarogr. Soc.
Journal of the Polarographic Society *(England)*

J. Polym. Sci. Pt. A
Journal of Polymer Science. Part A: General Papers *(U. S.)*

J. Polym. Sci., Pt. A–1
*Journal of Polymer Science, Part A–1: Polymer Chemistry *(U. S.)*

J. Polym. Sci., Pt. A–2
*Journal of Polymer Science, Part A–2: Polymer Physics *(U. S.)*

J. Polym. Sci. Pt. B
*Journal of Polymer Science. Part B: Polymer Letters *(U. S.)*

J. Polym. Sci. Pt. C
*Journal of Polymer Science. Part C: Polymer Symposia *(U. S.)*

J. Prakt. Chem.
Journal fuer Praktische Chemie *(Germany)*

J. Prosth. Dent.
Journal of Prosthetic Dentistry, The *(U. S.)*

J. Quant. Spectros. Radiative Transfer

*Journal of Quantitative Spectroscopy & Radiative Transfer *(England)*

J. Radiat. Res. (Jap.)
*Journal of Radiation Research *(Japan)*

J. Radiol., Electrol. Med. Nucl.
*Journal de Radiologie, d'Electrologie, et de Medicine Nucleaire *(France)*

J. Res. Inst. Catalysis, Hokkaido Univ.
Journal of the Research Institute for Catalysis, Hokkaido University *(Japan)*

J. Res. Nat. Bur. Stand., A
*Journal of Research of the National Bureau of Standards, A *(U. S.)*

J. Res. Nat. Bur. Stand., B
*Journal of Research of the National Bureau of Standards, B *(U. S.)*

J. Res. Nat. Bur. Stand., D
Journal of Research of the National Bureau of Standards, D *(U. S.)*

J. Reticuloendothel. Soc.
*Journal of the Reticuloendothelial Society *(U. S.)*

J. Roy. Microscop. Soc.
Journal of the Royal Microscopical Society *(England)*

J. S. Afr. Chem. Inst.
Journal of the South African Chemical Institute *(S. Africa)*

J. Sanit. Eng. Div., Amer. Soc. Civil Eng.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers *(U. S.)*

J. San'yo Ass. Advance. Sci. Eng.
Journal of the San'yo Association for Advancement of Science and Engineering
see San'yo Gijutsu Zasshi

J. Sci. Food Agr.
*Journal of the Science of Food and Agriculture *(England)*

J. Sci. Hiroshima Univ. Ser. A-II
*Journal of Science of the Hiroshima University. Series A-II *(Japan)*

J. Sci. Ind. Res. (India)
*Journal of Scientific and Industrial Research *(India)*

J. Sci. Instrum.
*Journal of Scientific Instruments *(England)*

J. Sci. Med. Lille
Journal des Sciences Medicales de Lille *(France)*

J. Soc. High Pressure Gas Ind.
Journal of the Society of High Pressure Gas Industry
see Koatsu Gasu Kyokaishi

J. Soc. Psychol.
Journal of Social Psychology *(U. S.)*

J. Spacecraft Rockets
Journal of Spacecraft and Rockets *(U. S.)*

J. Surg. Res.
Journal of Surgical Research *(U. S.)*

J. Tenn. Acad. Sci.
*Journal of the Tennessee Academy of Science *(U. S.)*

J. Theoret. Biol.
*Journal of Theoretical Biology *(England)*

J. Ultrastruct. Res.
*Journal of Ultrastructure Research *(U. S.)*

Junkatsu
Junkatsu (Journal of Japan Society of Lubrication Engineers) *(Japan)*

J. Urol.
Journal of Urology, The *(U. S.)*

J. Vac. Sci. Technol.
*Journal of Vacuum Science and Technology, The *(U. S.)*

J. Water Pollut. Contr. Federation
Journal of the Water Pollution Control Federation (formerly Sewage and Industrial Wastes) *(U. S.)*

Kagoshima Daigaku Igaku Zasshi
Kagoshima Daigaku Igaku Zasshi (Medical Journal of Kagoshima University) *(Japan)*

Keikinzoku
Keikinzoku (Light Metals (Tokyo)) *(Japan)*

Kernenergie
*Kernenergie *(Germany)*

Kerntechnik
*Kerntechnik, Isotopentechnik und -Chemie *(Germany)*

KFKI Kozlem.
KFKI Kozlemenyei
see Magyar Tud. Akad. Kozp. Fiz. Kut. Int. Kozlem.

Kibernetika
*Kibernetika *(Ukrainian S.S.R.)*

Kinet. Kataliz
*Kinetika i Kataliz† *(U.S.S.R.)*

Kinzoku Butsuri
Kinzoku Butsuri (Metal Physics) *(Japan)*

Kinzoku Zairyo Gijutsu Kenkyusho Kenkyu Hokoku
Kinzoku Zairyo Gijutsu Kenkyusho Kenkyu Hokoku (Report of National Research Institute for Metals) *(Japan)*

Kisul Yon'guso Pogo
Kisul Yon'guso Pogo (Report of the Army Research and Testing Laboratory) (supersedes Kwayon Hwibo) *(Korea)*

Klin. Khir.
Klinicheskaya Khirurgiya *(Ukrainian S.S.R.)*

Klin. Med. (Vienna)
Klinische Medizin (Vienna) *(Austria)*

Klin. Monatsbl. Augenheilk.
Klinische Monatsblaetter fuer Augenheilkunde und fuer Augenaerztliche Fortbildung *(Germany)*

Klin. Wochensch.
*Klinische Wochenschrift *(Germany)*

Koatsu Gasu Kyokaishi
Koatsu Gasu Kyokaishi (Journal of the Society of High Pressure Gas Industry) *(Japan)*

Kobe J. Med. Sci.
Kobe Journal of the Medical Sciences, The *(Japan)*

Kobe Shosen Daigaku Kiyo. Dai-2-Rui. Kokai, Kikan, Rigaku-hen
Kobe Shosen Daigaku Kiyo. Dai-2-Rui. Kokai, Kikan, Rigaku-hen. (Review of Kobe University of Mercantile Marine. Part II. Navigation, Marine Engineering, and Scientific Section) *(Japan)*

Kobunshi Kagaku
Kobunshi Kagaku (Chemistry of High Polymers) *(Japan)*

Kogyo Kagaku Zasshi
Kogyo Kagaku Zasshi (Journal of the Chemical Society of Japan, Industrial Chemistry Section) *(Japan)*

K'o Hsueh T'ung Pao
*K'o Hsueh T'ung Pao (Scientia) *(China)*

Kolloid-Z.
Kolloid-Zeitschrift *(Germany)*

Kongel. Dan. Vidensk. Selsk., Mat.-Fys. Medd.
*Kongelige Danske Videnskabernes Selskab, Det, Matematisk-Fysiske Meddelelser *(Denmark)*

Kongel. Dan. Vidensk. Selsk., Mat.-Fys. Skr.
*Kongelige Danske Videnskabernes Selskab, Det, Matematisk-Fysiske Skrifter *(Denmark)*

Kongel. Norske Vidensk. Selsk., Forh.
*Kongelige Norske Videnskabers Selskabs, Det, Forhandlinger *(Norway)*

Koninkl. Ned. Akad. Wetensch., Proc., Ser. B.
*Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series B *(Netherlands)*

Koninkl. Ned. Akad. Wetensch., Proc., Ser. C
Koninklijke Nederlandse Akademie van Wetenschappen, Proceedings, Series C *(Netherlands)*

Koshu Eiseiin Kenkyu Hokoku
Koshu Eiseiin Kenkyu Hokoku (Bulletin of the Institute of Public Health) *(Japan)*

Kosm. Issled.
*Kosmicheskie Issledovaniya† *(U.S.S.R.)*

Kosmos (Warsaw) Ser. A
*Kosmos (Warsaw) Seria A: Biologia *(Poland)*

Kozp. Elelmiszeripari Kutatoint. Kozlem.
Kozponti Elelmiszeripari Kutatointezet Kozlemenyei, A *(Hungary)*

Krebsarzt
Krebsarzt, Der *(Austria)*

Krupp Tech. Rev. (Engl. Transl. Tech. Mitt. Krupp, Werksber.)
*Krupp Technical Review (English Translation of Technische Mitteilungen Krupp, Werksberichte) *(Germany)*

Kumamoto Igakkai Zasshi
Kumamoto Igakkai Zasshi (The Journal of the Kumamoto Medical Society) *(Japan)*

Kurume Med. J.
Kurume Medical Journal, The *(Japan)*

Kwart. Geol.
*Kwartalnik Geologiczny *(Poland)*
Kyushu Journal of Medical Science *(Japan)*

Lab. Invest.
Laboratory Investigation *(U. S.)*

Kyushu Daigaku Kogaku Shuho
Kyushu Daigaku Kogaku Shuho (Technology Reports of the Kyushu University) *(Japan)*

Kyushu J. Med. Sci.

Lab. Pract.
Laboratory Practice *(England)*
Lancet
Lancet, The *(England)*
Laryngoscope
Laryngoscope, The *(U. S.)*
Latv. PSR Zinat. Akad. Vestis
*Latvijas PSR Zinatnu Akademijas Vestis *(Latvian S.S.R.)*
Latv. PSR Zinat. Akad. Vestis, Fiz. Tek. Zinat. Ser.
*Latvijas PSR Zinatnu Akademijas Vestis, Fizikas un Teknisko Zinatnu Serija *(Latvian S.S.R.)*
Laval Med.
Laval Medical *(Canada)*
Leder
Leder, Das *(Germany)*
Lietuvos Fiz. Rinkinys, Lietuvos TSR Mokslu Akad., Lietuvos TSR Aukstosios Mokyklos
*Lietuvos Fizikos Rinkinys, Lietuvos TSR Mokslu Akademija, Lietuvos TSR Aukstosios Mokyklos *(Lithuanian S.S.R.)*
Lietuvos TSR Mokslu Akad. Darbai: Ser. B
*Lietuvos TSR Mokslu Akademija Darbai: Serija B *(Lithuanian S.S.R.)*
Life Sci.
Life Sciences *(U. S.)*
Light Metals
Light Metals *(England)*
Lille Med.
*Lille Medical *(France)*
Limnol. Oceanog.
*Limnology and Oceanography *(U. S.)*
Lit. Mat. Sb.
*Litovskii Matematicheskikh Sbornik *(Lithuanian S.S.R.)*
Lockheed Ga. Quart.
*Lockheed Georgia Quarterly *(U. S.)*
Lodz. Tow. Nauk., Wydz. III, Acta Chim.
*Lodzkie Towarzystwo Naukowe, Wydzial III, Acta Chimica *(Poland)*
Lyon Chir.
Lyon Chirurgical *(France)*
Lyon Med.
Lyon Medical *(France)*
Mach. Lloyd
*Machinery Lloyd *(England)*
Madjalah Inst. Tek. Bandung Proc.
*Madjalah Institut Teknologi Bandung Proceedings *(Indonesia)*
Magnit. Gidrodin.
*Magnitnaya Gidrodinamika *(Latvian S.S.R.)*
Magyar Fiz. Foly.
*Magyar Fizikai Folyoirat *(Hungary)*
Magyar Kem. Foly.
*Magyar Kemiai Folyoirat *(Hungary)*
Magyar Kem. Lapja
*Magyar Kemikusok Lapja *(Hungary)*
Magyar Radiol.
*Magyar Radiologia *(Hungary)*
Magyar Tud. Akad. At. Kut. Int. (Debrecen). Kozlem.
Magyar Tudomanyos Akademia Atommag Kutato Intezete (Debrecen). Kozlemenyek
see **At. Kozlem.**
Magyar Tud. Akad. Kozp. Fiz. Kut. Int. Kozlem.
*Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezetenek Kozlemenyei *(Hungary)*
Magyar Tud. Akad. Mat. Fiz. Tud. Osztalyanak Kozlem.
*Magyar Tudomanyos Akademia Matematikai es Fizikai Tudomanyok Osztalyanak Kozlemenyei, A *(Hungary)*
Magyar Tud. Akad., Muszaki Tud. Osztalyanak Kozlem.
*Magyar Tudomanyos Akademia Muszaki Tudomanyok Osztalyanak Kozlemenyei *(Hungary)*
Magyar Tud. Akad. Tihanyi Biol. Kutatointez. Evkonyve
*Magyar Tudomanyos Akademia Tihanyi Biologiai Kutatointezetenek Evkonyve, A *(Hungary)*
Makromol. Chem.
Makromolekulare Chemie *(Switzerland)*
Mal. Cardiov.
*Malattie Cardiovascolari *(Italy)*
Maryland State Med. J.
Maryland State Medical Journal *(U. S.)*
Mater. Design Eng.
*Materials in Design Engineering (formerly Materials & Methods) *(U. S.)*
Mater. Eval.
*Materials Evaluation (formerly Nondestructive Testing) *(U. S.)*
Mater. Protect.
Materials Protection *(U. S.)*
Mater. Res. Stand.
*Materials Research & Standards (Formerly ASTM (American Society for Testing Materials) Bulletin) *(U. S.)*
Mayo Clin. Proc.
Mayo Clinic Proceedings *(U. S.)*
Mech. Eng.
Mechanical Engineering *(U. S.)*
Med. Ann.
Medical Annual *(England)*
Med. Ann. Dist. Columbia
Medical Annals of the District of Columbia *(U. S.)*
Med. Biol. Illus.
Medical and Biological Illustration *(England)*
Med. Clin. (Barcelona)
Medicina Clinica (Barcelona) *(Spain)*
Med. Dosw. Mikrobiol.
*Medycyna Doswiadczalna i Mikrobiologia *(Poland)*
Medd. Sundhedsstyr.
Meddelelser fra Sundhedsstyrelsen (Supplement to Ugeskrift for Laeger) *(Denmark)*
Med. Exp.
*Medicina Experimentalis *(Switzerland)*
Med. Glas.
*Medicinski Glasnik *(Yugoslavia)*
Medicamundi
*Medicamundi *(Netherlands)*
Medicina (Mex.)
*Medicina *(Mexico)*
Medicine (Tokyo)
Medicine (Tokyo)
see **Sogo Igaku**
Med. Interna
Medicina Interna *(Romania)*
Med. J. Hiroshima Univ.
Medical Journal of Hiroshima University
see **Hiroshima Daigaku Igaku Zasshi**
Med. J. Kagoshima Univ.
Medical Journal of Kagoshima University
see **Kagoshima Daigaku Igaku Zasshi**
Med. J. Malaya
*Medical Journal of Malaya, The *(Malaya)*
Med. J. Shinshu Univ.
*Medical Journal of Shinshu University *(Japan)*
Med. Klin. (Munich)
Medizinische Klinik (Munich) *(Germany)*
Med. Lavoro
Medicina del Lavoro, La *(Italy)*
Med. Officer
Medical Officer *(England)*
Med. Pracy
*Medycyna Pracy *(Poland)*
Med. Radiol.
*Meditsinskaya Radiologiya *(U.S.S.R.)*
Med. Rec. Ann.
Medical Record and Annals *(U. S.)*
Med. Serv. J. (Can.)
Medical Service Journal *(Canada)*
Med. Times
Medical Times *(U. S.)*
Med. Welt
Medizinsche Welt, Die *(Germany)*
Mem. Acad. Roy. Med. Belg.
*Memoires de l'Academie Royale de Medecine de Belgique *(Belgium)*
Mem. Activ. Desarrolladas Patronato "Juan de la Cierva" Invest. Tec., Consejo Super. Invest. Cient.
*Memoria de las Actividades Desarrolladas por el Patronato "Juan de la Cierva" de Investigacion Tecnica, Consejo Superior de Investigaciones Cientificas *(Spain)*
Mem. Coll. Sci., Univ. Kyoto, Ser. B
*Memoirs of the College of Science, University of Kyoto, Series B *(Japan)*
Mem. Fac. Eng., Nagoya Univ.
Memoirs of the Faculty of Engineering, Nagoya University *(Japan)*
Mem. Inst. Sci. Ind. Res. Osaka Univ.
Memoirs of the Institute of Scientific and Industrial Research, Osaka University *(Japan)*
Mem. Roy. Astron. Soc.
*Memoirs of the Royal Astronomical Society *(England)*

Mem. Sci. Rev. Met.
*Memoires Scientifiques de la Revue de Metallurgie, Les (formerly a part of Revue de Metallurgie) *(France)*

Mem. Soc. Roy. Sci. Liege
*Memoires de la Societe Royale des Sciences de Liege *(Belgium)*

Metall
*Metall *(Germany)*

Metalloved. Term. Obrabotka Metal.
*Metallovedenie i Termicheskaya Obrabotka Metallov† (formerly Metallovedenie i Obrabotka Metallov) *(U.S.S.R.)*

Metallurgia
*Metallurgia *(England)*

Metal Phys.
Metal Physics
see *Kinzoku Butsuri*

Metal Progr.
*Metal Progress *(U. S.)*

Metals Eng. Quart.
*Metals Engineering Quarterly *(U. S.)*

Metalurgia (Bucharest)
Metalurgia (Bucharest) *(Romania)*

Metaux (Corros.-Ind.)
*Metaux (Corrosion-Industries) *(France)*

Meteorol. Geoastrophys. Abstr.
Meteorological and Geoastrophysical Abstracts *(U. S.)*

Meteorol. Gidrol.
Meteorologiya i Gidrologiya *(U.S.S.R.)*

Meteorol. Rundschau
Meteorologische Rundschau *(Germany)*

Meteorol. Zpr.
*Meteorologicke Zpravy *(Czechoslovakia)*

Methods Cell Physiol.
Methods in Cell Physiology *(U. S.)*

Met. Ital.
*Metallurgia Italiana, La *(Italy)*

Met. Rev.
*Metallurgical Reviews *(England)*

Microbiology (USSR) (Engl. Transl.)
Microbiology (USSR) (English Translation of Mikrobiologiya) *(U. S.)*

Microchem. J.
*Microchemical Journal *(U. S.)*

Mikrochim. Ichnoanal. Acta
*Mikrochimica et Ichnoanalytica Acta (formerly Mikrochimica Acta) *(Austria)*

Mil. Med.
Military Medicine *(U. S.)*

Mineral. J. (Tokyo)
Mineralogical Journal (Tokyo) *(Japan)*

Minerva Chir.
Minerva Chirgica *(Italy)*

Minerva Med.
Minerva Medica *(Italy)*

Minerva Nucl.
*Minerva Nucleare *(Italy)*

Minerva Radiol., Fisioterap. Radiobiol.
*Minerva Radiologica, Fisioterapica e Radiobiologica *(Italy)*

Mining Can.
*Mining in Canada (formerly Precambrian) *(Canada)*

Mining J. (London)
Mining Journal (London) *(England)*

Minn. Med.
Minnesota Medicine *(U. S.)*

Mitsubishi Denki Giho
Mitsubishi Denki Giho *(Japan)*

Mitsui Tech. Rev.
Mitsui Technical Review
see *Mitsui Zosen Giho*

Mitsui Zosen Giho
Mitsui Zosen Giho (Mitsui Technical Review) *(Japan)*

Mitteilungsbl. Strahlungsmessgeraete
*Mitteilungsblaetter Strahlungsmessgeraete *(Germany)*

Mitt. Geb. Lebensmitteluntersuch. Hyg.
Mitteilungen aus dem Gebiete der Lebensmitteluntersuchung und Hygiene *(Switzerland)*

Mitt. Oesterr. Sanitaetsverwalt.
Mitteilungen der Oesterreischen Sanitaetsverwaltung *(Austria)*

Mod. Cast.
Modern Castings (includes New Technology Section) *(U. S.)*

Mod. Power Eng.
*Modern Power and Engineering *(Canada)*

Mod. Treat.
Modern Treatment *(U. S.)*

Mol. Phys.
*Molecular Physics *(U. S.)*

Monatsber. Deut. Akad. Wiss. Berlin
*Monatsberichte der Deutschen Akademie der Wissenschaften zu Berlin *(Germany)*

Monatsh. Chem.
Monatshefte fuer Chemie und Verwandte Teile Anderer Wissenschaften *(Austria)*

Monatsschr. Ohrenheilk. Laryngo-Rhinol.
Monatsschrift fuer Ohrenheilkunde und Laryngo-Rhinologie *(Austria)*

Mon. Notic. Roy. Astron. Soc.
*Monthly Notices of the Royal Astronomical Society *(England)*

Montpellier Med.
*Montpellier Medical *(France)*

Mosquito News
Mosquito News *(U. S.)*

MSU (Mich. State Univ.) Vet.
MSU (Michigan State University) Veterinarian *(U. S.)*

Mutat. Res.
*Mutation Research *(Netherlands)*

Mycologia
Mycologia *(U. S.)*

Nagasaki Igakkai Zasshi
Nagasaki Igakkai Zasshi (Journal of the Nagasaki Medical Association) *(Japan)*

Nagoya J. Med. Sci.
Nagoya Journal of Medical Science, The *(Japan)*

Nagoya Kogyo Gijutsu Shikensho Hokoku
Nagoya Kogyo Gijutsu Shikensho Hokoku (Reports of the Government Industrial Research Institute, Nagoya) *(Japan)*

Nat. Inst. Anim. Health Quart.
*National Institute of Animal Health Quarterly (Tokyo) *(Japan)*

Nature
*Nature (London) *(England)*

Naturwissenschaften
*Naturwissenschaften, Die *(Germany)*

Ned. Tijdschr. Geneesk.
Nederlandsch Tijdschrift voor Geneeskunde *(Netherlands)*

Ned. Tijdschr. Natuur.
*Nederlands Tijdschrift voor Natuurkunde *(Netherlands)*

Neoplasma
*Neoplasma *(Czechoslovakia)*

Neues Jahrb. Geol. Palaeontol., Monatsh.
Neues Jahrbuch fuer Geologie und Palaeontologie, Monatshefte *(Germany)*

Neue Tech.
*Neue Technik *(Switzerland)*

Neurol. Med. Chir.
Neurologia Medico Chirurgica *(Japan)*

Neurology
Neurology *(U. S.)*

New Engl. J. Med.
New England Journal of Medicine, The *(U. S.)*

New Phys. (Korea)
*New Physics *(Korea)*

New Sci.
*New Scientist, The *(England)*

New Zeal. J. Geol. Geophys.
New Zealand Journal of Geology and Geophysics *(New Zealand)*

Nippon Acta Radiol.
Nippon Acta Radiologica
see *Nippon Igaku Hoshasen Gakkai Zasshi*

Nippon Ganka Gakkai Zasshi
Nippon Ganka Gakkai Zasshi (Acta Societatis Ophthalmologicae Japonicae) *(Japan)*

Nippon Genshiryoku Gakkaishi
*Nippon Genshiryoku Gakkaishi (Journal of the Atomic Energy Society of Japan) *(Japan)*

Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo
*Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo (Annual Report of the Japanese Association for Radiation Research on Polymers) *(Japan)*

Nippon Igaku Hoshasen Gakkai Zasshi
Nippon Igaku Hoshasen Gakkai Zasshi (Nippon Acta Radiologica) *(Japan)*

Nippon Kagaku Zasshi

*Nippon Kagaku Zasshi (Journal of the Chemistry Society of Japan, Pure Chemistry Section) *(Japan)*

Nippon Kikai Gakkai Rombunshu
Nippon Kikai Gakkai Rombunshu (Transactions of the Japan Society of Mechanical Engineers) *(Japan)*

Nippon Kinzoku Gakkaishi
*Nippon Kinzoku Gakkaishi (Journal of the Japan Institute of Metals (Sendai)) *(Japan)*

Nippon Kokan Giho
Nippon Kokan Giho (Nippon Kokan Technical Report) *(Japan)*

Nippon Kokan Tech. Rep.
Nippon Kokan Technical Report
see Nippon Kokan Giho

Nippon Naibumpi Gakkai Zasshi
Nippon Naibumpi Gakkai Zasshi (Folia Endocrinologica Japonica) *(Japan)*

Nippon Nogeikagaku Kaishi
Nippon Nogeikagaku Kaishi (Journal of the Agricultural Chemical Society of Japan) *(Japan)*

Nippon Sanka Fujinka Gakkai Zasshi
Nippon Sanka Fujinka Gakkai Zasshi (Journal of Japanese Obstetrics and Gynecology) *(Japan)*

Nippon Siusan Gakkaishi
Nippon Siusan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) *(Japan)*

NML (Nat. Met. Lab.) Tech. J. (Jamshedpur, India)
NML (National Metallurgical Laboratory) Technical Journal (Jamshedpur, India) *(India)*

Norsk Geol. Tidsskr.
Norsk Geologisk Tidsskrift *(Norway)*

Notas Fis., Cent. Brasil. Pesqui. Fis.
*Notas de Fisica, Centro Brasileiro de Pesquisas Fisicas *(Brazil)*

Nouv. Rev. Franc. Hematol.
Nouvelle Revue Francaise d'Hematologie *(France)*

Novenytermeles
Novenytermeles *(Hungary)*

Nowotwory
Nowotwory *(Poland)*

NTZ-Nachrtech. Z.
NTZ-Nachrichtentechnische Zeitschrift *(Germany)*

Nucl. Appl.
*Nuclear Applications *(U. S.)*

Nucl. Energy
*Nuclear Energy (formerly Nuclear Energy Engineer) *(England)*

Nucl. Eng.
*Nuclear Engineering incorporating Nuclear Power *(England)*

Nucl. Eng. (Tokyo)
Nuclear Engineering (Tokyo)
see Genshiryoku Kogyo

Nucl. Eng. Bull.
*Nuclear Engineering Bulletin *(U. S.)*

Nucleonics
*Nucleonics *(U. S.)*

Nucleus (Calcutta)
Nucleus (Calcutta) *(India)*

Nucleus (Chicago)
Nucleus (Chicago), The *(U. S.)*

Nucleus (Lahore)
Nucleus (Lahore) *(Pakistan)*

Nucleus (Paris)
*Nucleus. La Revue Scientifique a l'Age Atomique (Paris) *(France)*

Nucl. Fusion
*Nuclear Fusion (Journal of Plasma Physics and Thermonuclear Fusion) *(Austria)*

Nucl. Ind.
Nuclear Industry *(U. S.)*

Nucl. Inform.
*Nuclear Information *(U. S.)*

Nucl. Instrum. Methods
*Nuclear Instruments & Methods (formerly Nuclear Instruments) *(Netherlands)*

Nucl.-Med.
*Nuclear-Medizin *(Germany)*

Nucl. News
*Nuclear News *(U. S.)*

Nucl. Phys.
*Nuclear Physics *(Netherlands)*

Nucl. Safety
*Nuclear Safety (A Quarterly Technical Progress Review) *(U. S.)*

Nucl. Sci. (Taiwan)
Nuclear Science (Taiwan) *(China)*
see Ho Tsu K'o Hsueh

Nucl. Sci. Abstr. Jap.
*Nuclear Science Abstracts of Japan *(Japan)*

Nucl. Sci. Appl.
*Nuclear Science and Applications *(Pakistan)*

Nucl. Sci. Eng.
*Nuclear Science and Engineering *(U. S.)*

Nucl. Struct. Eng.
*Nuclear Structural Engineering *(Netherlands)*

Nukl. Energ.
*Nukleama Energija *(Yugoslavia)*

Nukleonik
*Nukleonik *(Germany)*

Nukleonika
*Nukleonika† *(Poland)*

Nunt. Radiol.
*Nuntius Radiologicus *(Italy)*

Nuovi Ann. Ig. Microbiol.
Nuovi Annali d'Igiene e Microbiologia *(Italy)*

Nuovo Cimento
*Nuovo Cimento (Including all supplements) *(Italy)*

Nursing Res.
Nursing Research *(U. S.)*

N. Y. State Dent. J.
New York State Dental Journal *(U. S.)*

Obstet. Gynecol.
Obstetrics and Gynecology *(U. S.)*

Odontol. Revy
Odontologisk Revy *(Sweden)*

Oerlikon Schweissmitt.
Oerlikon Schweissmitteilungen *(Germany)*

Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Anz.
*Oesterreichische Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Klasse, Anzeiger *(Austria)*

Ogneupory
*Ogneupory† *(U.S.S.R.)*

Ohio J. Sci.
Ohio Journal of Science, The *(U. S.)*

Okayama Igakkai Zasshi
*Okayama Igakkai Zasshi (Journal of the Okayama Medical Society) *(Japan)*

Oncologia
*Oncologia *(Switzerland)*

Onde Elec.
*Onde Electrique, L' *(France)*

Ont. Hydro Res. News
*Ontario Hydro Research News *(Canada)*

Ophthalmol. Ibero-Amer.
*Ophthalmologia Ibero-Americana *(Brazil)*

Optik
Optik *(Germany)*

Opt. Spectros. (USSR) (Engl. Transl.)
*Optics and Spectroscopy (USSR) (English Translation of Optika i Spektroskopiya) *(U. S.)*

Oral Surg., Oral Med., Oral Pathol.
Oral Surgery, Oral Medicine, Oral Pathology *(U. S.)*

Orthodont. Franc.
Orthodontie Francaise *(France)*

Orv. Hetilap
Orvosi Hetilap *(Hungary)*

Osaka City Med. J.
*Osaka City Medical Journal *(Japan)*

Osaka-Furitsu Koshueisei Kenkyusho Kenkyu Hokoku
Osaka-Furitsu Koshueisei Kenkyusho Kenkyu Hokoku (Proceedings of the Osaka Public Health Institute) *(Japan)*

Osaka Shiritsu Daigaku Igaku Zasshi
*Osaka Shiritsu Daigaku Igaku Zasshi (The Journal of the Osaka City Medical Center) *(Japan)*

Oyo Butsuri
Oyo Butsuri (Journal of Applied Physics) *(Japan)*

Pakistan J. Sci. Ind. Res.
*Pakistan Journal of Scientific and Industrial Research *(Pakistan)*

Panminerva Med.
Panminerva Medica *(Italy)*

Papers Meteorol. Geophys. (Tokyo)
Papers in Meteorology and Geophysics (Tokyo) *(Japan)*

Paraplegia
Paraplegia *(Scotland)*

Pathol. Biol. Semaine Hop.

*Pathologie et Biologie, Archives de Biologie Medicale, Annales de la Recherche Medicale, La Semaine des Hopitaux *(France)*

Pathologica
*Pathologica *(Italy)*

Pediat. Prat.
*Pediatria Pratica *(Brazil)*

Pediatria (Santiago, Chile)
*Pediatria (Santiago, Chile) *(Chile)*

Pediatrics
Pediatrics *(U. S.)*

Percept. Motor Skills
Perceptual and Motor Skills *(U. S.)*

Perspect. Biol. Med.
*Perspectives in Biology and Medicine *(U. S.)*

Petrol. Chem. (USSR) (Engl. Transl.)
Petroleum Chemistry (USSR) (English Translation of Neftekhimiya) *(U. S.)*

Pharm. Acta Helv.
Pharmaceutica Acta Helvetiae *(Switzerland)* (Supplement to Schweizerische Apotheker-Zeitung)

Philips Res. Rep.
*Philips Research Reports *(Netherlands)*

Philips Tech. Rev.
*Philips Technical Review *(Netherlands)*

Phil. Mag.
*Philosophical Magazine, The *(England)*

Phil. Trans. Roy. Soc. London, Ser. A.
Philosophical Transactions of the Royal Society of London, Series A *(England)*

Photochem. Photobiol.
Photochemistry and Photobiology *(England)*

Photogr. Sci. Eng.
*Photographic Science and Engineering *(U. S.)*

Phys. Bl.
Physikalische Blaetter *(Germany)*

Phys. Can.
*Physics in Canada *(Canada)*

Phys. Fluids
*Physics of Fluids, The *(U. S.)*

Physica
*Physica *(Netherlands)*

Physics
*Physics *(U. S.)*

Physiol. Bohemoslov.
Physiologia Bohemoslovenica *(Czechslovakia)*

Physiol. Plant.
Physiologia Plantarum *(Denmark)*

Physiol. Zool.
Physiological Zoology *(U. S.)*

Physiotherapy (London)
Physiotherapy (London) *(England)*

Phys. Kondens. Mater.
*Physik der Kondensierten Materie *(Germany)*

Phys. Lett.
*Physics Letters *(Netherlands)*

Phys. Med. Biol.
*Physics in Medicine and Biology *(England)*

Phys. Rev.
*Physical Review, The *(U. S.)*

Phys. Rev. Lett.
*Physical Review Letters *(U. S.)*

Phys. Status Solidi
*Physica Status Solidi *(Germany)*

Phys. Today
*Physics Today *(U. S.)*

Phyton (Buenos Aires)
Phyton (Buenos Aires) *(Argentina)*

Phytopathology
Phytopathology *(U. S.)*

Planet. Space Sci.
*Planetary and Space Science *(England)*

Planseeber. Pulvermet.
*Planseeberichte fuer Pulvermetallurgie Vereinigt mit Powder Metallurgy Bulletin *(Austria)*

Plant Physiol.
*Plant Physiology *(U. S.)*

Plasma Phys.-Accel.-Thermonucl. Res., J. Nucl. Energy: Pt. C
Plasma Physics-Accelerators-Thermonuclear Research, Journal of Nuclear Energy: Part C
see *J. Nucl. Energy: Pt. C*

Plast. Reconstr. Surg.
Plastic and Reconstructive Surgery and the Transplantation Bulletin *(U. S.)*

Plating
Plating *(U. S.)*

Plzensky Lek. Sb.
Plzensky Lekarsky Sbornik *(Czechoslovakia)*

Pochvovedenie
Pochvovedenie† *(U.S.S.R.)*

Pokroky Mat. Fys. Astron.
*Pokroky Matematiky, Fysiky a Astronomie *(Czechoslovakia)*

Pol. Arch. Med. Wewn.
Polskie Archiwum Medycyny Wewnetrznej *(Poland)*

Pol. Przegl. Radiol. Med. Nuklearnej
*Polski Przeglad Radiologii i Medycyny Nuklearnej *(Poland)*

Pol. Tyg. Lek.
Polski Tygodnik Lekarski *(Poland)*

Polymer
*Polymer *(England)*

Porosh. Met., Akad. Nauk Ukr. SSR
*Poroshkovaya Metallurgiya, Akademiya Nauk Ukrainskoi SSR *(Ukrainian S.S.R.)*

Port. Phys.
Portugaliae Physica *(Portugal)*

Postepy Astron.
*Postepy Astronomii *(Poland)*

Postepy Biochem.
*Postepy Biochemii *(Poland)*

Postepy Fiz.
*Postepy Fizyki *(Poland)*

Postepy Hig. Med. Dosw.
*Postepy Higieny i Medycyny Doswiadczalnej *(Poland)*

Postepy Nauk Roln.
*Postepy Nauk Rolniczych *(Poland)*

Postgrad. Med.
Postgraduate Medicine *(U. S.)*

Postgrad. Med. J. (London)
Postgraduate Medical Journal (London) *(England)*

Powder Met.
*Powder Metallurgy *(England)*

Power
*Power with which are consolidated Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer, and Operating Engineer *(U. S.)*

Power Eng.
Power Engineering *(U. S.)*

Power Reactor Technol.
*Power Reactor Technology (A Quarterly Technical Progress Review) *(U. S.)*

Prace Cent. Inst. Ochrony Pracy
Prace Centralnego Instytutu Ochrony Pracy *(Poland)*

Prace Inst. Hutn.
*Prace Instytutow Hutniczych *(Poland)*

Prac. Lek.
*Pracovni Lekarstvi *(Czechoslovakia)*

Prakt. Metallog.
*Praktische Metallographie *(Germany)*

Praxis Pneumol.
Praxis der Pneumologie, Vereinigt mit "Der Tuberkulosearzt" *(Germany)*

Presse Med.
Presse Medicale, La *(France)*

Prib. Tekh. Eksp.
*Pribory i Tekhnika Eksperimenta† *(U.S.S.R.)*

Prikl. Mat. Mekh.
*Prikladnaya Matematika i Mekhanika† *(U.S.S.R.)*

Primena Radioakt. Izotop. Joniz. Zracenja Med.
*Primena Radioaktivnih Izotopa i Jonizujucih Zracenja u Medicini *(Yugoslavia)*

Priroda
*Priroda *(U.S.S.R.)*

Probl. Kosm. Biol.
Problemy Kosmicheskoi Biologii *(U.S.S.R.)*

Proc. Amer. Power Conf.
Proceedings of the American Power Conference *(U. S.)*

Proc. Ass. Offic. Seed Analysts
Proceedings of the Association of Official Seed Analysts *(U. S.)*

Proc. Brit. Ceram. Soc.
Proceedings of the British Ceramic Society *(England)*

Proc. Cambridge Phil. Soc.
Proceedings of the Cambridge Philosophical Society (England)

Proc. Geol. Ass. Can.
*Proceedings of the Geological Association of Canada *(Canada)*
Proc. IEEE (Inst. Elec. Electron. Eng.)
*Proceedings of the IEEE (Institute of Electrical and Electronics Engineers) (formerly Proceedings of the Institute of Radio Engineers) *(U. S.)*
Proc. Indiana Acad. Sci.
*Proceedings of the Indiana Academy of Science *(U. S.)*
Proc. Indian Acad. Sci., Sect. A
*Proceedings of the Indian Academy of Sciences, Section A *(India)*
Proc. Inst. Elec. Eng. (London)
*Proceedings of the Institution of Electrical Engineers, The (London) *(England)*
Proc. Int. Congr. Human Genet., 2nd, Rome, 1961
Proceedings of the International Congress of Human Genetics, 2nd Congress, Rome, Sept. 6-12, 1961 (Pub. 1963) *(Italy)*
Proc. Iowa Acad. Sci.
*Proceedings of the Iowa Academy of Science *(U. S.)*
Proc. La. Acad. Sci.
Proceedings of the Louisiana Academy of Sciences, The *(U. S.)*
Proc. Leeds Phil. Lit. Soc., Sci. Sect.
*Proceedings of the Leeds Philosophical and Literary Society, Scientific Section *(England)*
Proc. Nat. Acad. Sci. U. S.
*Proceedings of the National Academy of Sciences of the United States of America *(U. S.)*
Proc. Nat. Inst. Sci. India, Pt. A
*Proceedings of the National Institute of Sciences of India, Part A *(India)*
Proc. Nat. Inst. Sci. India, Pt. B
*Proceedings of the National Institute of Sciences of India, Part B *(India)*
Proc. Osaka Public Health Inst.
Proceedings of the Osaka Public Health Institute
see Osaka-Furitsu Koshueisei Kenkyusho Kenkyu Hokoku
Proc. Phys. Seminar Trondheim
Proceedings of the Physics Seminar in Trondheim
see Ark. Fys. Seminar Trondheim
Proc. Phys. Soc. (London)
*Proceedings of the Physical Society (London), The *(England)*
Proc. Res. Inst. Nucl. Med. Biol.
*Proceedings of Research Institute for Nuclear Medicine and Biology *(Japan)*
Proc. Roy. Inst. Great Brit.
Proceedings of the Royal Institution of Great Britain *(England)*
Proc. Roy. Irish Acad., Sect. A
*Proceedings of the Royal Irish Academy, Section A *(Ireland)*
Proc. Roy. Soc. Edinburgh, A
*Proceedings of the Royal Society of Edinburgh, Section A *(Scotland)*
Proc. Roy. Soc. (London), Ser. A
*Proceedings of the Royal Society (London), Series A *(England)*
Proc. Roy. Soc. (London), Ser. B
*Proceedings of the Royal Society (London), Series B *(England)*
Proc. Roy. Soc. Med.
Proceedings of the Royal Society of Medicine *(England)*
Proc. Soc. Exp. Biol. Med.
*Proceedings of the Society for Experimental Biology and Medicine *(U. S.)*
Proc. Vibration Probl.
*Proceedings of Vibration Problems *(Poland)*
Progr. Astronaut. Aeronaut.
*Progress in Astronautics and Aeronautics *(U. S.)*
Progr. Clin. Cancer
Progress in Clinical Cancer *(U. S.)*
Progr. Cryog.
*Progress in Cryogenics *(England)*
Progr. Elem. Particle Cosmic Ray Phys.
*Progress in Elementary Particle and Cosmic Ray Physics *(U. S.–Netherlands)*
Progr. Exp. Tumor Res.
Progress in Experimental Tumor Research *(Switzerland)*
Progr. Inorg. Chem.
*Progress in Inorganic Chemistry *(U. S.)*
Progr. Low Temp. Phys.
*Progress in Low Temperature Physics *(Netherlands)*
Progr. Nucleic Acid Res.
*Progress in Nucleic Acid Research *(U. S.)*
Progr. Nucl. Energy, Ser. I
*Progress in Nuclear Energy, Series I *(England–U. S.)*
Progr. Nucl. Energy, Ser. II
*Progress in Nuclear Energy, Series II *(England–U. S.)*
Progr. Nucl. Energy, Ser. V
*Progress in Nuclear Energy, Series V *(England–U. S.)*
Progr. Nucl. Energy, Ser. VIII
*Progress in Nuclear Energy, Series VIII *(England–U. S.)*
Progr. Nucl. Energy, Ser. X
*Progress in Nuclear Energy, Series X *(England–U. S.)*
Progr. Nucl. Phys.
*Progress in Nuclear Physics *(U. S.)*
Progr. Radiat. Therapy
Progress in Radiation Therapy *(U. S.)*
Progr. React. Kinet.
*Progress in Reaction Kinetics *(U. S.)*
Progr. Sci. Technol. Rare Earths
*Progress in the Science and Technology of the Rare Earths *(U. S.)*
Progr. Stereochem.
*Progress in Stereochemistry *(U. S.)*
Progr. Theoret. Phys. (Kyoto)
*Progress of Theoretical Physics (Kyoto) *(Japan)*
Progr. Theoret. Phys. (Kyoto), Suppl.
*Progress of Theoretical Physics (Kyoto), Supplement *(Japan)*
Protides Biol. Fluids, Proc. Colloq.
*Protides of the Biological Fluids, Proceedings of the Colloquium *(Belgium)*
Protoplasma
Protoplasma *(Austria)*
Przegl. Elektron.
*Przeglad Elektroniki *(Poland)*
Przegl. Geofiz.
*Przeglad Geofizyczny *(Poland)*
Przegl. Geol.
*Przeglad Geologiczny *(Poland)*
Przegl. Odlewnictwa
*Przeglad Odlewnictwa *(Poland)*
Przem. Chem.
*Przemysl Chemiczny *(Poland)*
Psychol. Rep.
Psychological Reports *(U. S.)*
Pub. Lab. Fis. Cosm., Univ. Mayor San Andres
*Publicaciones del Laboratorio de Fisica Cosmica, Universidad Mayor de San Andres *(Bolivia)*
Public Health Eng. Abstr.
*Public Health Engineering Abstracts *(U. S.)*
Public Health Rep. (U. S.)
*Public Health Reports *(U. S.)*
Pub. Res. Inst. Math. Sci., Ser. A
*Publications of the Research Institute for Mathematical Sciences, Series A *(Japan)*
Pub. Res. Inst. Math. Sci., Ser. B
*Publications of the Research Institute for Mathematical Sciences, Series B *(Japan)*
Pure Appl. Chem.
*Pure and Applied Chemistry (The Official Journal of the International Union of Pure and Applied Chemistry) *(U. S.)*
Pure Appl. Geophys.
*Pure and Applied Geophysics (formerly Geofizika Pura e Aplicata) *(Switzerland)*
Quad. Clin. Obstet. Ginecol.
Quaderni di Clinica Obstetrica e Ginecologica *(Italy)*
Quad. Radiol.
Quaderni di Radiologia *(Italy)*
Quart. Appl. Math.
*Quarterly of Applied Mathematics *(U. S.)*
Quart. J. Med.
Quarterly Journal of Medicine, The *(England)*
Quart. J. Roy. Astron. Soc.
*Quarterly Journal of the Royal Astronomical Society, The *(England)*
Quart. Rev. Biol.
Quarterly Review of Biology, The *(U. S.)*
Quart. Rev. (London)
*Quarterly Reviews (London) *(England)*
Queensland J. Agr. Anim. Sci.
*Queensland Journal of Agricultural and Animal Science (formerly Queensland Journal of Agricultural Science) *(Australia)*
Radiat. Bot.
*Radiation Botany *(England)*
Radiat. Res.

*Radiation Research *(U. S.)*
Radiaz. Alta Energ.
Radiazioni di Alta Energia *(Italy)*
Radioact. Sea
*Radioactivity in the Sea *(Austria)*
Radiobiol. Lat.
*Radiobiologica Latina *(Italy)*
Radiobiologiya
*Radiobiologiya† *(U.S.S.R.)*
Radiobiol. Radioterap. Fis. Med.
*Radiobiologia, Radioterapia e Fisica Medica (formerly Radioterapia, Radiobiologia e Fisica Medica) *(Italy)*
Radiobiol.-Radiotherap.
*Radiobiologia–Radiotherapie *(Germany)*
Radiocarbon
*Radiocarbon *(U. S.)*
Radiochim. Acta
*Radiochimica Acta *(Germany)*
Radio Electron. Eng.
Radio and Electronic Engineer, The *(England)*
Radiographer
Radiographer *(Australia)*
Radiography
Radiography *(England)*
Radioisotopes (Tokyo)
*Radioisotopes (Tokyo) *(Japan)*
Radiokhimiya
*Radiokhimiya† *(U.S.S.R.)*
Radiol. Austr.
Radiologia Austriaca *(Austria)*
Radiol. Clin. Biol.
*Radiologia Clinica et Biologica (formerly Radiologia Clinica) *(Switzerland)*
Radiol. Clin. N. Amer.
Radiologic Clinics of North America *(U. S.)*
Radiol. Diagn.
*Radiologia Diagnostica *(Germany)*
Radiol. Health Data
*Radiological Health Data *(U. S.)*
Radiol. Med.
*Radiologia Medica, La *(Italy)*
Radiologe
Radiologe *(Germany)*
Radiologia (Panama)
Radiologia *(Panama)*
Radiology
*Radiology *(U. S.)*
Radiol. Technol.
Radiologic Technology (formerly X-Ray Technician) *(U. S.)*
Radio Sci.
*Radio Science (formerly Journal of Research of the National Bureau of Standards, D) *(U. S.)*
Radiotekhn. Elektron.
*Radiotekhnika i Elektronika† *(U.S.S.R.)*
Rass. Fisiopatol. Clin. Terap.
Rassegna di Fisiopatologia Clinica e Terapeutica *(Italy)*
Raumfahrtforschung
*Raumfahrtforschung (formerly Raketentechnik und Raumfahrtforschung) *(Germany)*
RCA Rev.
*RCA Review *(U. S.)*
Reactor Fuel Process.
*Reactor Fuel Processing (A Quarterly Technical Progress Review) *(U. S.)*
Reactor Mater.
*Reactor Materials (A Quarterly Technical Progress Review) *(U. S.)*
Reactor Sci. Technol., J. Nucl. Energy: Pt. A & B
Reactor Science and Technology, Journal of Nuclear Energy: Parts A & B
see J. Nucl. Energy: Pt. A & B
Rec. Elec. Commun. Eng. Conversation, Tohoku Univ.
Record of Electrical and Communication Engineering Conversation, Tohoku University, The
see Tohoku Daigaku Denki Tsushin Kogaku Kenkyusho Kiroku
Rec. Oceanogr. Works Jap.
Records of Oceanographic Works in Japan *(Japan)*
Rec. Trav. Chim.
*Recueil des Travaux Chimiques des Pays-Bas *(Netherlands)*
Regelungstechnik
Regelungstechnik *(Germany)*
Rendic. Ist. Sci. Univ. Camerino
Rendiconti degli Istituti Scientifici della Universita di Camerino *(Italy)*
Rendic. Ist. Super. Sanita
Rendiconti Istituto Superiore di Sanita *(Italy)*
Rep. Army Res. Testing Lab.
Report of the Army Research and Testing Laboratory
see Kisul Yon'guso Pogo
Rep. Gov. Chem. Ind. Res. Inst., Tokyo
Reports of the Government Chemical Industrial Research Institute, Tokyo
see Tokyo Kogyo Shikensho Hokoku
Rep. Gov. Ind. Res. Inst., Nagoya
Reports of the Government Industrial Research Institute, Nagoya
see Nagoya Kogyo Gijutsu Shikensho Hokoku
Rep. Inst. Phys. Chem. Res. (Tokyo)
Reports of the Institute of Physical and Chemical Research (Tokyo)
see Rika Gaku Kenkyusho Hokoku
Rep. Ionosphere Space Res. Jap.
*Report of Ionosphere and Space Research in Japan *(Japan)*
Rep. Kihara Inst. Biol. Res.
Reports of the Kihara Inst. for Biological Research
see Seiken Jiho
Rep. Nat. Res. Inst. Metals
Report of National Research Institute for Metals
see Kinzoku Zairyo Gijutsu Kenkyusho Kenkyu Hokoku
Rep. Progr. Phys.
*Reports on Progress in Physics *(England)*
Rep. Res. Inst. Elec. Commun., Tohoku Univ.
*Reports of the Research Institute of Electrical Communication, Tohoku University, The *(Japan)*
Rep. Transport. Tech. Res. Inst. (Tokyo)
Report of Transportation Technical Research Institute (Tokyo) *(Japan)*
RES; J. Reticuloendothel. Soc.
RES; Journal of the Reticuloendothelial Society
see J. Reticuloendothel. Soc.
Res. Reactor J.
*Research Reactor Journal *(U. S.)*
Res. Rev. (Office Aerospace Res.)
*Research Review (Office of Aerospace Research) *(U. S.)*
Res. Technol. Briefs
Research and Technology Briefs *(U. S.)*
Reumatismo
*Reumatismo *(Italy)*
Rev. Alumin.
Revue de l'Aluminium *(France)*
Rev. Argent. Alergia
*Revista Argentina de Alergia *(Argentina)*
Rev. Argent. Anestesiol.
*Revista Argentina de Anestesiologia *(Argentina)*
Rev. Argent. Tuberc. Enferm. Pulmonares
*Revista Argentina de Tuberculosis y Enfermedades Pulmonares *(Argentina)*
Rev. Asoc. Med. Rio Grande do Sul
*Revista da Asociacao Medica do Rio Grande do Sul *(Brazil)*
Rev. Belge Pathol. Med. Exp.
*Revue Belge de Pathologie et de Medecine Experimentale *(Belgium)*
Rev. Brasil. Gastroenterol.
*Revista Brasileira de Gastroenterologia *(Brazil)*
Rev. Brasil. Med.
Revista Brasileira de Medicina *(Brazil)*
Rev. Can. Biol.
*Revue Canadienne de Biologie *(Canada)*
Rev. Chil. Pediat.
*Revista Chilena de Pediatria *(Chile)*
Rev. Col. Med. Guatemala
*Reviste del Colegio Medico de Guatemala *(Guatemala)*
Rev. Cubana Cardiol.
*Revista Cubana de Cardiologia *(Cuba)*
Rev. Electrotech. Energ., Acad. Repub. Pop. Roum.
*Revue d'Electrotechnique et d'Energetique, Academie de la Republique Populaire Roumaine *(Romania)*
Rev. Espan. Fisiol.
*Revista Espanola de Fisiologia *(Spain)*
Rev. Espan. Oto-neuro-oftalmol. Neurocir.
*Revista Espanola de Oto-neuro-oftalmologia y Neurocirugia *(Spain)*

Rev. Espan. Reum. Enferm. Osteoarticul.
*Revista Espanola de Reumatismo y Enfermedades Osteo-articulares *(Spain)*

Rev. Espan. Tuberc.
*Revista Espanola de Tuberculosis y Archivos Nacionales de Enfermedades del Torax *(Spain)*

Rev. Franc. Endocrinol. Clin.
Revue Francaise d'Endocrinologie Clinique, Nutrition et Metabolisme *(France)*

Rev. Franc. Etud. Clin. Biol.
*Revue Francaise d'Etudes Cliniques et Biologiques *(France)*

Rev. Gen. Bot.
Revue Generale Botanique *(France)*

Rev. Gen. Elec.
*Revue Generale de l'Electricite *(France)*

Rev. Geophys.
*Reviews of Geophysics *(U. S.)*

Rev. Ginecol. Obstet. (Rio de Janeiro)
*Revista de Ginecologia e d'Obstetricia (Rio de Janeiro) *(Brazil)*

Rev. Goiana Med.
*Revista Goiana de Medicina *(Brazil)*

Rev. Hautes Temp. Refract.
*Revue des Hautes Temperatures et des Refractaires *(France)*

Rev. Hosp. Clin., Fac. Med., Univ. Sao Paulo
*Revista do Hospital das Clinicas, Faculdade de Medicina, Universidade de Sao Paulo *(Brazil)*

Rev. Hosp. Nino (Lima)
*Revista del Hospital del Nino (Lima) *(Peru)*

Rev. Hosp. San Juan de Dios (Bogota)
*Revista del Hospital de San Juan de Dios (Bogota) *(Colombia)*

Rev. Iberica Endocrinol.
*Revista Iberica de Endocrinologia *(Spain)*

Rev. Immunol.
*Revue d'Immunologie et de Therapie Antimicrobienne *(France)*

Rev. Inst. Ing. Elec.
*Revista del Instituto de Ingenieria Electrica *(Argentina)*

Rev. Inst. Med. Trop. Sao Paulo
*Revista do Instituto de Medicina Tropical de Sao Paulo *(Brazil)*

Rev. Int. Serv. Sante Armees Terre Mer Air
Revue Internationale des Services de Sante des Armees de Terre de Mer et de l'Air *(Belgium)*

Rev. Invest. Clin. Org. Hosp. Enferm. Nutr. Mex.
*Revista de Investigacion Clinica, Organo del Hospital de Enfermedades de la Nutricion, Mexico *(Mexico)*

Rev. Kobe Univ. Mercantile Marine. Pt. II. Navigation, Marine Eng. Sci. Sect.
Review of Kobe University of Mercantile Marine. Part II. Navigation, Marine Engineering, and Scientific Section **see Kobe Shosen Daigaku Kiyo. Dai-2-Rui. Kokai, Kikan, Rigaku-hen**

Rev. Latinoamer. Anat. Patol.
*Revista Latinoamericana de Anatomia Patologica *(Venezuela)*

Rev. Latino-Amer. Cir. Plastica
*Revista Latinoamericana de Cirugia Plastica *(Mexico)*

Rev. Latinoamer. Microbiol.
*Revista Latinoamericana de Microbiologia *(Mexico)*

Rev. Leprol. (Fontilles)
*Revista de Leprologia (Fontilles) *(Spain)*

Rev. M.B.L.E.
*Revue de Manufacture Belge de Lampes et de Materiel *(Belgium)*

Rev. Med. Aeronaut. (Paris)
Revue de Medecine Aeronautique (Paris) *(France)*

Rev. Med. Aeronaut. (Rio de Janeiro)
*Revista Medica da Aeronautica (Rio de Janeiro) *(Brazil)*

Rev. Med. Cordoba
*Revista Medica de Cordoba *(Argentina)*

Rev. Med. Hosp. Colonia (Mex.)
*Revista Medica del Hospital Colonia *(Mexico)*

Rev. Med. Hosp. Espan. (Mex.)
*Revista Medica del Hospital Espanol *(Mexico)*

Rev. Med. Hosp. Obrero (Lima)
*Revista Medica del Hospital Obrero (Lima) *(Peru)*

Rev. Med. Rio Grande do Sul
*Revista de Medicina do Rio Grande do Sul *(Brazil)*

Rev. Med. Valparaiso
*Revista Medica de Valparaiso *(Chile)*

Rev. Met. (Paris)
*Revue de Metallurgie (Paris) *(France)*

Rev. Metal Lit.
*Review of Metal Literature *(U. S.)*

Rev. Mex. Cienc. Med. Biol.
*Revista Mexicana de Ciencias Medicas y Biologicas *(Mexico)*

Rev. Mex. Cir. Ginecol. Cancer
*Revista Mexicana de Cirugia, Ginecologia y Cancer *(Mexico)*

Rev. Mex. Fis.
*Revista Mexicana de Fisica *(Mexico)*

Rev. Mex. Tuberc. Aparato Resp.
*Revista Mexicana de Tuberculosis y Aparato Respiratorio *(Mexico)*

Rev. Mod. Phys.
*Reviews of Modern Physics *(U. S.)*

Rev. Neurol. Buenos Aires
*Revista Neurologica de Buenos Aires *(Argentina)*

Rev. Obstet. Ginecol. (Caracas)
*Revista de Obstetricia y Ginecologia (Caracas) *(Venezuela)*

Rev. Opt.
Revue d'Optique, Theorique et Instrumentale *(France)*

Rev. Ortoped. Traumatol. Latinoamer.
*Revista de Ortopedia y Traumatologia Latinoamericana *(Argentina)*

Rev. Otorrinolaringol. (Santiago, Chile)
*Revista de Otorrinolaringologia (Santiago, Chile) *(Chile)*

Rev. Phys., Acad. Repub. Pop. Roum.
*Revue de Physique, Academie de la Republique Populaire Roumaine *(Romania)*

Rev. Port. Quim. (Lisbon)
*Revista Portuguesa de Quimica (Lisbon) *(Portugal)*

Rev. Psiquiat. (Santiago, Chile)
*Revista de Psiquiatria (Santiago, Chile) *(Chile)*

Rev. Psiquiat. Peru.
*Revista Psiquiatrica Peruana *(Peru)*

Rev. Pure Appl. Chem.
*Reviews of Pure and Applied Chemistry *(Australia)*

Rev. Quest. Sci.
Revue des Questions Scientifiques *(Belgium)*

Rev. Rhum.
*Revue du Rhumatisme et des Maladies Osteo-Articulaires *(France)*

Rev. Roum. Biochim.
Revue Roumaine de Biochimie *(Romania)*

Rev. Roum. Chim.
*Revue Roumaine de Chimie (continuation of Revue de Chimie, Academie de la Republique Populaire Roumaine) *(Romania)*

Rev. Roum. Phys.
Revue Roumaine de Physique *(Romania)*

Rev. Sci. Instrum.
*Review of Scientific Instruments, The *(U. S.)*

Rev. Soc. Med.-Quir. Zulia
*Revista de la Sociedad Medico-Quirurgica del Zulia *(Venezuela)*

Rev. Surg.
Review of Surgery *(U. S.)*

Rev. Tuberc. (Paris)
Revue de la Tuberculose (Paris) *(France)*

Rev. Union Mat. Argent. Asoc. Fis. Argent.
*Revista de la Union Matematica Argentina y de la Asociacion Fisica Argentina *(Argentina)*

Rev. Univ. Ind. Santander
*Revista de la Universidad Industrial de Santander *(Colombia)*

Rev. Univ. Madrid
Revista de la Universidad de Madrid *(Spain)*

Rev. Urol. (Caracas)
*Revista de Urologia (Caracas) *(Venezuela)*

Rev. Urol. (Mex.)
*Revista de Urologia *(Mexico)*

Rheumatism
*Rheumatism *(England)*

Ric. Sci. Rend., Sez. A
*Ricerca Scientifica, La. Parte 2: Rendiconti, Sezione A, Abiologica *(Italy)*

Ric. Sci. Rend., Sez. B
*Ricerca Scientifica, La. Parte 2: Rendiconti, Sezione B, Biologica *(Italy)*

Rika Gaku Kenkyusho Hokoku
*Rika Gaku Kenkyusho Hokoku (Reports of the Institute of Physical and Chemical Research) *(Japan)*

Rinsho Hoshasen
Rinsho Hoshasen (Clinical Radiology) *(Japan)*

Riv. Biol.
Rivista di Biologia (Pubblicata a Cura dell'Istituto di Biologia Generale dell'Universita di Perugia) *(Italy)*

Riv. Clin. Pediat.
*Rivista di Clinica Pediatrica *(Italy)*

Riv. Ing. Nucl.
*Rivista di Ingegneria Nucleare *(Italy)*

Riv. Ist. Sieroterap. Ital.
*Rivista dell'Istituto Sieroterapico Italiano *(Italy)*

Riv. Ital. Ig.
Rivista Italiana d'Igiene *(Italy)*

Rivoluzione Ind.
*Rivoluzione Industriale *(Italy)*

Riv. Ostet. Ginecol.
Rivista di Ostetricia e Ginecologia *(Italy)*

Riv. Patol. Clin. Sperim.
Rivista di Patologia Clinica e Sperimentale *(Italy)*

Rocz. Chem.
*Roczniki Chemii *(Poland)*

Rocz. Nauk Roln., Ser. A
Roczniki Nauk Rolniczych, Seria A *(Poland)*

Rocz. Panstw. Zakladu Hig.
*Roczniki Panstwowego Zakladu Higieny *(Poland)*

Rocz. Technol. Chem. Zywnosci
Rocznik Technologii i Chemii Zywnosci *(Poland)*

Roentgen Bl.
Roentgen Blaetter *(Germany)*

Rozpr. Elektrotech.
*Rozprawy Elektrotechniczne *(Poland)*

Rubber Age (N. Y.)
Rubber Age, The (New York) *(U. S.)*

Rudy Metale Niezelazne
*Rudy i Metale Niezelazne *(Poland)*

Rum. Med. Rev.
*Rumanian Medical Review *(Romania)*

SAE (Soc. Automotive Eng.) J.
SAE (Society of Automotive Engineers) Journal *(U. S.)*

S. Afr. J. Agr. Sci.
South African Journal of Agricultural Science *(S. Africa)*

S. Afr. J. Obstet. Gynaecol.
South African Journal of Obstetrics and Gynaecology *(South Africa)*

S. Afr. J. Radiol.
*South African Journal of Radiology *(S. Africa)*

Salud Publica Mex.
Salud Publica de Mexico *(Mexico)*

Santo Tomas J. Med.
*Santo Tomas Journal of Medicine *(Philippines)*

San'yo Gijutsu Zasshi
San'yo Gijutsu Zasshi (Journal of the San'yo Association for Advancement of Science and Engineering) *(Japan)*

Sb. Lekar.
Sbornik Lekarsky *(Czechoslovakia)*

Sb. Nauch. Tr. Inst. Metallofiz., Akad. Nauk Ukr. SSR
Sbornik Nauchnykh Trudov Instituta Metallofiziki, Akademiya Nauk Ukrainskoi SSR (formerly Sbornik Nauchnykh Rabot Instituta Metallofiziki, Akademiya Nauk Ukrainskoi SSR) *(Ukrainian S.S.R.)*

Sb. Ved. Pract Lekar. Fak. Karlovy Univ. Hradci Kralove
*Sbornik Vedeckych Praci Lekarske Fakulty Karlovy University v Hradci Kralove *(Czechoslovakia)*

Scand. J. Clin. Lab. Invest.
Scandinavian Journal of Clinical & Laboratory Investigation *(Denmark)*

Scand. J. Haematol.
*Scandinavian Journal of Haematology *(Denmark)*

Schriftenreihe Bundesmin. Wiss. Forsch., Forsch. Bild.
*Schriftenreihe des Bundesministers fuer Wissenschaftliche Forschung, Forschung und Bildung *(Germany)*

Schriftenreihe Bundesmin. Wiss. Forsch., Kernenergierecht
*Schriftenreihe des Bundesministers fuer Wissenschaftliche Forschung, Kernenergierecht (formerly Schriftenreihe des Bundesministers fuer Atomkernenergie und Wasserwirtschaft, Kernenergierecht) *(Germany)*

Schriftenreihe Bundesmin. Wiss. Forsch., Radionukl.
*Schriftenreihe des Bundesministers fuer Wissenschaftliche Forschung, Radionuklide *(Germany)*

Schriftenreihe Bundesmin. Wiss. Forsch., Strahlenschutz (Munich)
*Schriftenreihe des Bundesministers fuer Wissenschaftliche Forschung, Strahlenschutz (Munich) *(Germany)*

Schweiz. Arch. Angew. Wiss. Tech.
*Schweizer Archiv fuer Angewandte Wissenschaft und Technik *(Switzerland)*

Schweiz. Med. Wochschr.
Schweizerische Medizinische Wochenschrift *(Switzerland)*

Sci. Amer.
*Scientific American *(U. S.)*

Sci. Citizen
Scientist and Citizen (formerly Nuclear Information) *(U. S.)*

Sci. Cult. (Calcutta)
Science and Culture (Calcutta) *(India)*

Science
*Science *(U. S.)*

Scientia (Peking)
Scientia (Peking)
see K'o Hsueh T'ung Pao

Scientia (Valparaiso, Chile)
*Scientia (Valparaiso, Chile) *(Chile)*

Sci. J.
*Science Journal *(England)*

Sci. Light (Tokyo)
Science of Light (Tokyo) *(Japan)*

Sci. Papers Coll. Gen. Educ., Univ. Tokyo
*Scientific Papers of the College of General Education, University of Tokyo *(Japan)*

Sci. Papers Inst. Phys. Chem. Res. (Tokyo)
*Scientific Papers of the Institute of Physical and Chemical Research (Tokyo) (formerly Journal of the Scientific Research Institute (Tokyo)) *(Japan)*

Sci. Progr. (London)
*Science Progress (London) *(England)*

Sci. Progr.-Nature
*Science Progres-La Nature *(France)*

Sci. Rep. Kanazawa Univ.
Science Reports of the Kanazawa University, The *(Japan)*

Sci. Rep. Res. Inst. Theoret. Phys., Hiroshima Univ.
*Scientific Reports of the Research Institute for Theoretical Physics, Hiroshima University *(Japan)*

Sci. Rep. Res. Inst., Tohoku Univ., Ser. A
*Scientific Reports of the Research Institutes, The, Tohoku University, Series A *(Japan)*

Sci. Rep. Saitama Univ., Ser. A
*Science Reports of Saitama University, The, Series A *(Japan)*

Sci. Rep. Tohoku Univ., Fifth Ser.
Science Reports of the Tohoku University, Fifth Series *(Japan)*

Sci. Rev. (Manila)
*Science Review (Manila) *(Philippines)*

Sci. Sinica (Peking)
*Scientia Sinica (Peking) (Chung Kuo K'o Hsueh) *(China)*

Scot. Med. J.
Scottish Medical Journal *(Scotland)*

Seiken Jiho
*Seiken Jiho (Reports of the Kihara Inst. for Biological Research) *(Japan)*

Sem. Hop. Paris
Semaine des Hopitaux de Paris, La *(France)*

Shih Yen Sheng Wu Hsueh Pao
Shih Yen Sheng Wu Hsueh Pao (Acta Biologicae Experimentalis Sinica) *(China)*

Shikoku Acta Med.
Shikoku Acta Medica
see Shikoku Igaku Zasshi

Shikoku Igaku Zasshi
*Shikoku Igaku Zasshi (Shikoku Acta Medica) *(Japan)*

Shinku Kagaku
Shinku Kagaku (Vacuum Chemistry) *(Japan)*

Siemens Rev.
Siemens Review *(Germany)*

Sitzungsber. Ges. Befoerd. Ges. Naturwiss. Marburg
*Sitzungsberichte der Gesellschaft zur Befoerderung der Gesamten Naturwissenschaften zu Marburg *(Germany)*

S. Med. J.
Southern Medical Journal *(U. S.)*

Soc. Sci. Fenn., Comment. Phys.-Math.
Societas Scientiarum Fennica, Commentationes Physico-Mathematicae *(Finland)*

Sogo Igaku
Sogo Igaku (Medicine) *(Japan)*

Soil Sci.
*Soil Science *(U. S.)*

Soil Sci. Soc. Amer., Proc.
*Soil Science Society of America, Proceedings *(U. S.)*

Solar Energy
Solar Energy *(U. S.)*

Solid State Commun.
*Solid State Communications *(U. S.)*
Solid-State Electron.
Solid-State Electronics *(U. S.)*
Solid State Phys.
*Solid State Physics *(U. S.)*
Soudage Tech. Connexes
Soundage et Techniques Connexes *(France)*
Southwestern Vet.
Southwestern Veterinarian, The *(U. S.)*
Soviet Astron.-AJ (Engl. Transl.)
*Soviet Astronomy—AJ (English Translation of Astronomicheskii Zhurnal) *(U. S.)*
Soviet J. Non-Ferrous Metals (Engl. Transl.)
Soviet Journal of Non-Ferrous Metals, The (English Translation of Tsvetnye Metally) *(U. S.)*
Soviet Phys.–Cryst. (Engl. Transl.)
*Soviet Physics—Crystallography (English Translation of Kristallografiya) *(U. S.)*
Soviet Phys.-Solid State (Engl. Transl.)
*Soviet Physics—Solid State (English translation of Fizika Tverdogo Tela) *(U. S.)*
Space/Aeronaut.
*Space/Aeronautics *(U. S.)*
Space Sci. Rev.
*Space Science Reviews *(Netherlands)*
Spectrochim. Acta
*Spectrochimica Acta *(England)*
Sperimentale
Sperimentale, Lo *(Italy)*
Stain Technol.
Stain Technology *(U. S.)*
Staub
*Staub *(Germany)*
Stomatologiya
Stomatologiya *(U.S.S.R.)*
Strahlentherapie
*Strahlentherapie *(Germany)*
Strahlentherapie, Sonderbaende
*Strahlentherapie, Sonderbaende *(Germany)*
Stud. Cercet. Energ. Electroteh.
Studii si Cercetari de Energetica si Electrotehnica *(Romania)*
Stud. Cercet. Fiz.
*Studii si Cercetari de Fizica (formerly Academia Republicii Populare Romine, Institutul de Fizica Atomica si Institutul de Fizica, Studii si Cercetari de Fizica) *(Romania)*
Stud. Math.
*Studia Mathematica *(Poland)*
Stud. Med. Szeged.
*Studia Medica Szegedinensia *(Hungary)*
Stud. Univ. Babes-Bolyai, Ser. Biol.
Studia Universitatis Babes-Bolyai, Series Biologia *(Romania)*
Stud. Univ. Babes-Bolyai, Ser. Chem.
*Studia Universitatis Babes-Bolyai, Series Chemia *(Romania)*
Stud. Univ. Babes-Bolyai, Ser. Math.-Phys.
*Studia Universitatis Babes-Bolyai, Series Mathematica-Physica *(Romania)*
Sulyokaishi
Suiyokaishi (Transactions of the Mining and Metallurgical Alumni Association) *(Japan)*
Sulzer Tech. Rev. (Switz.)
*Sulzer Technical Review *(Switzerland)*
Sumitomo Denki
Sumitomo Denki (Sumitomo Electric Review) *(Japan)*
Sumitomo Elec. Rev.
Sumitomo Electric Review
see **Sumitomo Denki**
Sumitomo Elec. Tech. Rev.
*Sumitomo Electric Technical Review *(Japan)*
Surgery
Surgery *(U. S.)*
Surg., Gynecol. Obstet.
Surgery, Gynecology and Obstetrics with International Abstracts of Surgery *(U. S.)*
Ta Han Hua Hsueh Hui-Chih
Ta Han Hua Hsueh Hui-Chih (Journal of the Korean Chemical Society) *(Korea)*
Taiki Hoshano Kansoku Seiseki
*Taiki Hoshano Kansoku Seiseki (Bulletin of the Atmospheric Radioactivity) *(Japan)*
Talanta
*Talanta *(England)*
Tech. Mitt. Krupp. Forschungsber.
*Technische Mitteilungen Krupp. Forschungsberichte *(Germany)*
Technol. Rep. Kyushu Univ.
Technology Reports of the Kyushu University
see **Kyushu Daigaku Kogaku Shuho**
Tech. Rep. Eng. Res. Inst., Kyoto Univ.
*Technical Reports of the Engineering Research Institute, Kyoto University *(Japan)*
Tech. Sci. Aeronaut. Spatiales
Technique et Science Aeronautiques et Spatiales *(France)*
Tech. Ueberwach.
*Technische Ueberwachung *(Germany)*
Telecommun. J.
Telecommunication Journal *(Switzerland)*
Telefunken Zeit.
*Telefunken Zeitung *(Germany)*
Tellus
*Tellus. A Quarterly Journal of Geophysics *(Sweden)*
Teor. Eksp. Khim.
*Teoreticheskaya i Eksperimentalnaya Khimiya *(Ukrainian S.S.R.)*
Teploenergetika
*Teploenergetika *(U.S.S.R.)*
Teplofiz. Vysok. Temp.
*Teplofizika Vysokikh Temperatur† *(U.S.S.R.)*
Terap. Arkh.
Terapevticheskii Arkhiv *(U.S.S.R.)*
Tetrahedron
*Tetrahedron *(Northern Ireland)*
Tetrahedron Lett.
Tetrahedron Letters *(Northern Ireland)*
Tex. State J. Med.
Texas State Journal of Medicine *(U. S.)*
Textile Res. J.
Textile Research Journal *(U. S.)*
Thorax
Thorax *(England)*
Tidsskr. Kjemi, Bergv. Met.
*Tidsskrift for Kjemi, Bergvesen og Metallurgi *(Norway)*
Today's Health
Today's Health *(U. S.)*
Tohoku Daigaku Dentsu Danwakai Kiroku
Tohoku Daigaku Dentsu Danwakai Kiroku (The Record of Electrical and Communication Engineering Conversation, Tohoku University) *(Japan)*
Tohoku J. Exp. Med.
Tohoku Journal of Experimental Medicine, The *(Japan)*
Tokyo Daigaku Koku Kenkyusho Shuho
Tokyo Daigaku Koku Kenkyusho Shusho (Bulletin of the Aeronautical Research Institute, University of Tokyo) *(Japan)*
Tokushima J. Exp. Med.
*Tokushima Journal of Experimental Medicine, The *(Japan)*
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*Tokyo Kogyo Shikensho Hokoku (Reports of the Government Chemical Industrial Research Institute, Tokyo) *(Japan)*
Tool Manuf. Eng.
Tool and Manufacturing Engineer, The *(U. S.)*
Torax
*Torax *(Uruguay)*
Toshiba Rebyu
Toshiba Rebyu (Toshiba Review) *(Japan)*
Toshiba Rev., Int. Ed.
*Toshiba Review, International Edition *(Japan)*
Toxicol. Appl. Pharmacol.
Toxicology and Applied Pharmacology *(U. S.)*
Trans. AIME, Met. Soc.
Transactions of AIME, Metallurgical Society
see **Trans. Met. Soc. AIME**
Trans. Amer. Clin. Climatol. Ass.
Transactions of the American Clinical and Climatological Association *(U. S.)*
Trans. Amer. Geophys. Union
*Transactions of the American Geophysical Union *(U. S.)*
Trans. Amer. Nucl. Soc.
*Transactions of the American Nuclear Society *(U. S.)*
Trans. ASME (Amer. Soc. Mech. Eng.), Ser. A: J. Eng. Power
Transactions of the ASME (American Society of Mechanical

Engineers), Series A: Journal of Engineering for Power
see J. Eng. Power

Trans. ASME (Amer. Soc. Mech. Eng.), Ser. C: J. Heat Transfer
Transactions of the ASME (American Society of Mechanical Engineers), Series C: Journal of Heat Transfer
see J. Heat Transfer

Trans. ASME (Amer. Soc. Mech. Eng.), Ser. D: J. Basic Eng.
Transactions of the ASME (American Society of Mechanical Engineers), Series D: Journal of Basic Engineering
see J. Basic Eng.

Trans. ASME (Amer. Soc. Mech. Eng.), Ser. E: J. Appl. Mech.
Transactions of the ASME (American Society of Mechanical Engineers), Series E: Journal of Applied Mechanics
see J. Appl. Mech.

Trans. Bose Res. Inst. (Calcutta)
*Transactions of the Bose Research Institute (Calcutta) *(India)*

Trans. Brit. Ceram. Soc.
*Transactions of the British Ceramic Society incorporating British Ceramic Abstracts *(England)*

Trans. Can. Inst. Mining Met.
*Transactions of the Canadian Institute of Mining and Metallurgy and of the Mining Society of Nova Scotia *(Canada)*

Trans. Chalmers Univ. Technol., Gothenburg
*Transactions of Chalmers University of Technology, Gothenburg, Sweden *(Sweden)*

Trans. Eng. Inst. Can.
*Transactions of the Engineering Institute of Canada *(Canada)*

Trans. Faraday Soc.
*Transactions of the Faraday Society *(England)*

Trans. Indian Inst. Metals
*Transactions of the Indian Instiute of Metals *(India)*

Trans. Jap. Inst. Metals
*Transactions of the Japan Institute of Metals (Sendai) *(Japan)*

Trans. Met. Soc. AIME
*Transactions of the Metallurgical Society of AIME (American Institute of Mining, Metallurgical, and Petroleum Engineers) *(U. S.)*

Trans. Mining Met. Alumni Ass.
Transactions of the Mining and Metallurgical Alumni Association
see Suiyokaishi

Trans. New Engl. Obstet. Gynecol. Soc.
Transactions of the New England Obstetrical and Gynecological Society *(U. S.)*

Trans. N. Y. Acad. Sci.
*Transactions of the New York Academy of Sciences *(U. S.)*

Transplantation
*Transplantation (formerly Transplantation Bulletin) *(U. S.)*

Trans. Roy. Soc. Can.
*Transactions of the Royal Society of Canada *(Canada)*

Trend Eng. Univ. Wash.
*Trend in Engineering at the University of Washington *(U. S.)*

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*Trudy Energeticheskogo Instituta imeni I. G. Es'mana, Akademiya Nauk Azerbaidzhanskoi SSR *(Azerbaidzhan S.S.R.)*

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Turrialba *(Costa Rica)*

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*TVF (Teknisk-Vetenskaplig Forskning) *(Sweden)*

Ukr. Biokhim. Zh.
*Ukrainskii Biokhimichnii Zhurnal *(Ukrainian S.S.R.)*

Ukr. Fiz. Zh.
*Ukrainskii Fizichnii Zhurnal *(Ukrainian S.S.R.)*

Ukr. Khim. Zh.
*Ukrainskii Khimicheskii Zhurnal *(Ukrainian S.S.R.)*

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*Ukrainskii Matematicheskii Zhurnal *(Ukrainian S.S.R.)*

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Ulster Medical Journal *(Northern Ireland)*

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Umschau ueber die Fortschritte in Wissenschaft und Technik, Die *(Germany)*

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*Umweltradioaktivitaet und Strahlenbelastung *(Germany)*

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*Union Medicale du Canada, L' *(Canada)*

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*Universite de Bruxelles, Institut de Physique, Bulletin *(Belgium)*

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*Verhandlungen der Deutschen Gesellschaft fuer Pathologie *(Germany)*

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*Vide, Le, Technique-Applications *(France)*
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*Vijnana Parishad Anusandhan Patrika *(India)*
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*Voprosy Onkologii *(U.S.S.R.)*
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Weld. Design Fabr.
Welding Design and Fabrication *(U. S.)*
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*Welding Journal, The (New York) *(U. S.)*
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Wiad. Chem.
*Wiadomosci Chemiczne *(Poland)*
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Wiener Klinische Wochenschrift *(Austria)*
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Wiener Medizinische Wochenschrift *(Austria)*
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Wiener Zeitschrift fuer Nervenheilkunde und deren Grenzgebiete *(Austria)*
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Wissenschaftliche Zeitschrift der Friedrich-Schiller-Universitaet, Jena, Mathematisch-Naturwissenschaftliche Reihe *(Germany)*
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*Wissenschaftliche Zeitschrift der Humboldt-Universitaet zu Berlin, Mathematisch-Naturwissenschaftliche Reihe *(Germany)*
Wiss. Z. Tech. Univ. Dresden
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World Health Organ., Tech. Rep. Ser.
World Health Organization, Technical Report Series *(U. S.)*
World's Poultry Sci. J.
World's Poultry Science Journal *(U. S.)*
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*Wu Li Hsueh Pao (Acta Physica Sinica) *(China)*
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*Yadernaya Fizika† *(U.S.S.R.)*
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Yale J. Biol. Med.
*Yale Journal of Biology and Medicine, The *(U. S.)*
Yokohama Med. Bull.
*Yokohama Medical Bulletin *(Japan)*
Yonsei Med. J.
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Yosetsu Gakkaishi
Yosetsu Gakkaishi (Journal of the Japan Welding Society) *(Japan)*
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*Zeitschrift fuer Alternsforschung *(Germany)*
Z. Anal. Chem.
*Zeitschrift fuer Analytische Chemie, Fresenius' *(Germany)*
Z. Angew. Geol.
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*Zeitschrift fuer Angewandte Mathematik und Physik *(Switzerland)*
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*Zeitschrift fuer Anorganische und Allgemeine Chemie *(Germany)*
Zashchita Metal.
*Zashchita Metallov *(U.S.S.R.)*
Zastosowania Mat.
*Zastosowania Matematyki *(Poland)*
Z. Astrophys.
*Zeitschrift fuer Astrophysik *(Germany)*
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*Zavodskaya Laboratoriya† *(U.S.S.R.)*
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Zentralbl. Bakteriol., Parasitenk., Abt. I. Orig.
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Zentralblatt fuer Veterinaermedizin *(Germany)*
Z. Erzbergbau Metallhuettenw.
Zeitschrift fuer Erzbergbau und Metallhuettenwesen *(Germany)*
Zesz. Nauk. Akad. Gorn.-Hutn. Krakowie, Rozpr.
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Zeitschrift fuer Geburtshilfe und Gynaekologie *(Germany)*

Z. Geophys.
Zeitschrift fuer Geophysik *(Germany)*

Z. Gesam. Exp. Med.
*Zeitschrift fuer Gesamte Experimentelle Medizin Zugleich Fortsetzung der Zeitschrift fuer Experimentelle Pathologie und Therapie *(Germany)*

Z. Gesam. Inn. Med. Ihre Grenz.
*Zeitschrift fuer die Gesamte Innere Medizine und Ihre Grenzgebiete *(Germany)*

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Zeitschrift fuer Haut- und Geschlechtskrankheiten *(Germany)*

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*Zeitschrift fuer Krebsforschung *(Germany)*

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*Zeitschrift fuer Naturforschung. Part b *(Germany)*

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